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Production and Consumption of Major Wood Products in the Lake States: Perspectives and Trends

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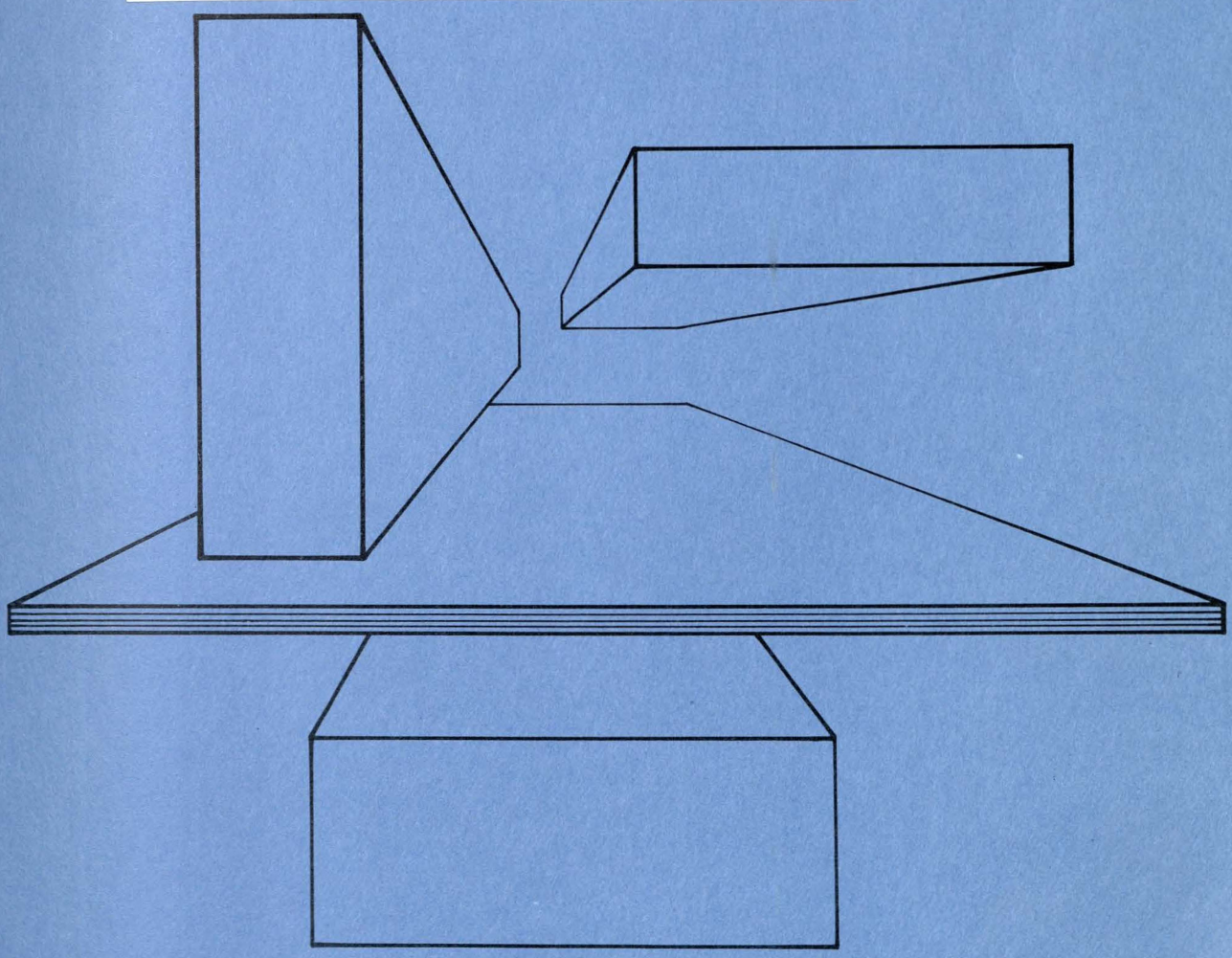

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PRODUCTION AND CONSUMPTION OF MAJOR WOOD PRODUCTS IN THE LAKE STATES: PERSPECTIVES AND TRENDS

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THE LAKE STATES REGION

Michigan, Minnesota, and Wisconsin comprise the Lake States, a region covering 191,000 square miles (5 percent of the total U.S. land area). More than 18 million people (8 percent of the total U.S. population) live within the region, most residing in the region's large southern metropolitan areas. Agriculture plays a major role in the southern part of the region, growing in significance toward the west. Timber production activities span the region's northern reaches, with associated wood products manufacturing occurring throughout the central and southern portions. Mining, primarily iron, concentrates in northeastern Minnesota yet stretches across northern Wisconsin and Michigan's Upper Peninsula. The region's expansiveness, significant population and important economic activities make the Lake States a vital part of the nation's political economy.

The recession of the early 1980's brought extraordinary economic hardship to the Lake States. Michigan, with its huge manufacturing sector, was particularly stricken. Unemployment in the State rose from 6.9 percent in 1978 to 15.5 percent in 1982, compared to a 1982 national unemployment rate of 9.7 percent (U.S. Department of Commerce, Bureau of the Census 1984). On average, Wisconsin and Minnesota fared slightly better; however, some areas, notably Minnesota's Iron Range, experienced unemployment rates approaching 20 percent. Many believed that the fundamental structure of some regional industries, especially mining and automobile manufacturing, was changing and that prospects for future employment in such industries were bleak. Each state undertook massive efforts to provide assistance and retraining programs for the unemployed in an effort to curb economic distress and stem the outflow of labor. The forest products sector, which directly employed more than 180 thousand workers in the region, was given particular attention since it had weathered the recession relatively well and the region contained vast and underutilized timber resources. Forestry officials within the region sought increased cooperation as a means of identifying new opportunities for development within the forest products sector.

FOREST PLANNING INFORMATION

State and federal forestry agencies within the Lake States have been involved with comprehensive forest planning activities since the early 1970's. These planning efforts intensified during the early 1980's, largely in response to the Forest and Rangeland Renewable Resources Planning Act, as amended by the National Forest Management Act of 1976. Forest resource managers and planners developed a common concern during this period about the quality, quantity and form of information available for planning purposes (Lewis and Ellefson 1983). The lack of adequate information presented a significant barrier to the development of long-term timber management strategies necessary to promote growth and stability in the Lake States forest products sector. Five problems were of special concern:

- Incomplete timber resource requirement projections for several geographic areas within the Lake States;
- Inconsistent forest resource plans among several government agencies, and between geographic areas;

- Misallocation of resources in attempting to efficiently meet forest resource requirements;
- Duplication of effort and costs in making various, limited timber supply and demand projections; and
- An inability to identify and resolve regional problems.

In an attempt to address some of these difficulties, a unique cooperative effort was undertaken. The Lake States Planning Coordination Committee initiated the effort. Financial support was provided by state forestry agencies in Minnesota, Michigan, and Wisconsin; USDA Forest Service National Forest Administration; USDA Forest Service Research; and the Department of Forest Resources, University of Minnesota[1]. The objectives of the cooperative agreement were to:

- Develop reliable estimates of current primary and secondary wood product production and consumption in the Lake States;
- Identify major issues related to the ability of Lake States timber resources to meet future timber requirements;
- Improve the consistency, reliability and availability of information pertaining to Lake States timber supply and demand; and
- Promote cooperation among the Lake States in addressing regional forestry problems and opportunities.

In pursuing these objectives, the perspective of forest resource managers and planners was maintained. The focus was on types of information necessary to develop workable strategies for meeting long-term timber resource demands in the Lake States. Relevent economic, technological and demographic factors were considered and characteristics of the region's timber resources explored in order to identify significant issues and opportunities.

REGIONAL TIMBER RESOURCES

Forest Land

Area

The Lake States is one of the nation's most densely forested regions, second only to New England. The 45.5 million acres of commercial forest land in the region, which represent nearly 10 percent of the national total, are distributed fairly evenly among the three states: Michigan, 17.5 million acres; Minnesota, 13.5 million acres; and Wisconsin, 14.5 million acres. Minnesota and Michigan have experienced significant reductions in commercial forest land since 1952. Minnesota's commercial forest land declined about 11 percent, largely as a result of the creation of the Voyageurs National Park and the expansion of the Boundary Waters Canoe Area (Jakes 1980a). Michigan's commercial forest land declined about 7 percent, due primarily to urban and related development, much of which occurred in the state's southern lower peninsula (Spencer 1983). Wisconsin's commercial forest land held fairly steady between 1952 and 1968 (Spencer and Thorne 1972). The state's 1983 forest survey, however, shows that commercial forest land increased by 1.5 percent since 1968 due to farmland in the southern part of the state reverting back to forest land. Despite Wisconsin's promising reversal, the trend toward a declining commercial forest land base remains an important forestry issue in the Lake States.

Ownership

Nearly half of the commercial forest land in the Lake States is publicly owned, with state and county ownership accounting for about 26 percent. This relatively high proportion of non-federal public forest land ownership is unique to the region and represents an opportunity for state and county forestry agencies to largely determine the future of the Lake States' forest.

Timber Resources

Forest Types

The region's forests can be characterized by six major forest types. Aspen-birch dominates the region, covering 32 percent of the commercial forest land, followed by maple-beech-birch (24 percent), spruce-fir (15 percent), oak-hickory (12 percent), white-red-jack pine (8 percent), and elm-ash-cottonwood (7 percent). About two percent of the region's commercial forest land is classified as nonstocked. There are some distinct differences between the states in the region. Minnesota is heavily dominated by aspen-birch (50 percent) while maple-beech-birch predominates in Michigan (35 percent). Wisconsin is dominated by roughly equal proportions of these two forest types.

[1]*Concurrent with this project was a study by the Conservation Foundation on forest policies in the Lake States which also encourages regional cooperation and coordination (Shands and Dawson 1984).*

Timber Volume

Hardwoods account for nearly three-fourths of the growing-stock volume in the region. The distribution of growing-stock volume among ownership classes is closely related to the distribution of commercial forest land. The proportion of hardwoods, however, varies among ownership classes, being slightly higher for private nonindustrial owners (about 80 percent) than for federal and state ownerships (about 60 percent).

Productivity

The average growing-stock volume per acre is relatively consistent across ownership classes in the Lake States. The regional average of 921 cubic feet per acre is low when compared to the national average of 1,466 cubic feet, partially reflecting small timber sizes and low levels of management intensity in the region (Jakes 1980a). But also, the average site class (i.e., a measure of potential site productivity assuming fully-stocked natural stands at culmination of mean annual increment) in the region is only 58 cubic feet per acre per year whereas the average site class in the nation is 73 cubic feet per acre per year. This measure suggests that the Lake States may have to overcome the disadvantage of having a less productive forest land base than other regions. However, the region holds the advantage of having greater opportunity to increase timber productivity, especially compared to the South which has nearly achieved its productive potential (Hagler 1983).

Age-Class Distribution

Stands between 40 and 60 years of age dominate commercial forest land in the Lake States and are evenly distributed among the three states. These stand-ages resulted from heavy cutting combined with fire and wind disturbances that occurred in the early part of the 20th century. Because two of the region's major species, aspen and birch, are relatively short-lived, many of the stands are beginning to deteriorate. Such deterioration implies a lost opportunity to utilize existing timber resources and a failure to achieve the physical capability of the land base to produce timber.

The skewed age-class distribution also raises an important and complex question: how can the "wall of wood" now occupying the Lake States forests be effectively utilized without entailing a subsequent decline in timber resource availability? Assumptions about the species composition of the Lake States "third forest" and increased growth rates after harvesting the slow-growing, mature timber carry significant implications.

Size-Class Distribution

The Lake States is the nation's only region dominated by pole-size timber. Forty-five percent of the region's commercial forest land is covered by poletimber, a distribution pattern which is fairly consistent across the three states. Although species composition, stocking levels and age class largely determine size, the size-class distribution pattern in the Lake States also can be attributed to regional timber industries that primarily harvest and process pole-size trees. Whether poletimber or larger-sized timber products should be the focus of the Lake State's third forest represents an important question for the region.

Growth and Removals

Despite an 8 percent reduction in commercial forest land between 1952 and 1977, growing stock volumes of hardwoods and softwoods in the Lake States increased at a faster rate than in any other region of the country (Jakes 1981). These increases were attributable in part to low levels of utilization. In 1977, for example, net annual hardwood growth exceeded removals by nearly 40 percent and softwood growth exceeded removals by 30 percent. Over the past few years, expansion in the pulp and paper industry, rapid growth in the structural particleboard industry and rising consumption of wood for energy have narrowed the gap between growth and removals. For aspen, the species in greatest demand, the gap might have closed completely (Shands and Dawson 1984). However, since a large proportion of the productive potential in the Lake States is not being achieved, there is opportunity to increase production and sustain growth in the timber product industries for some time (USDA Forest Service 1982).

Supply-Demand-Consumption Relations

The terms "timber supply," "timber demand," and "timber consumption" are often loosely used. Supply is sometimes confused with timber volume or growth while demand is misinterpreted as growing-stock removals or timber receipts at the mill gate. Supply and demand are economic variables affected by changes in numerous factors: population, income,

preferences, technology, etc. Timber supply refers to the volume that timber owners would be willing to sell at given stumpage prices at a given place and time. As stumpage prices rise owners presumably would be willing to offer greater volumes for sale. Stumpage price alone does not determine whether a particular timber stand would be made available for purchase. The stand must also be considered "operable" (i.e., logging and transportation costs must also be covered by the purchaser).

Timber demand refers to the volume of timber that users would be willing to purchase at given prices at a given place and time. Rising stumpage prices generally result in reduced timber purchases; however, timber demand is affected by important factors other than stumpage prices (e.g., population and income changes, shifts in the relative prices of final timber products and their substitutes, changes in society's preferences).

Timber consumption is the actual amount of timber which clears the market at a price agreed upon by seller and purchaser. In sum, timber supply, demand and consumption are determined by complex economic relationships and thus must be differentiated from information such as volume, growth, removals and receipts.

Regional Timber Demand

Relative Prices

Changes in relative stumpage prices often represent the driving force behind regional shifts in mill capacity and thus, regional timber demand (USDA Forest Service 1982). This is particularly true for the lumber industry in which stumpage prices represent a large percentage of the final product's selling price. For example, relative stumpage prices were critical factors in the shift of U.S. lumber production from the Pacific Northwest to the South. As competition for timber increases and stumpage prices rise in the South relative to other regions, lumber production may shift again, perhaps back to the Pacific Northwest.

Stumpage prices in the Lake States are relatively low. Furthermore, proximity to large Midwestern markets represents a competitive advantage for the region, particularly with respect to the West but also the South. The wood products industry has responded to these factors by locating several new mills in the region during the past few years. An important question is whether the region is capable of meeting the timber requirements of these and perhaps additional mills without incurring significant stumpage price increases.

Technology

Advances in technology have been critical to renewed interest in the Lake States forest. For example, new harvesting systems have responded to many problems associated with large volumes of pole-size timber; reconstituted board technologies have enabled industries to utilize pole-size timber for structural panel products (e.g., waferboard and oriented strand board); and hardwood species, especially aspen, have become extremely desirable for particleboard products and as a component of the woodpulp mix paper and board production. Other technologies, such as sawing and drying techniques that reduce the warpage in hardwood dimension lumber, are being developed that will continue to enhance the position of the Lake States as a supplier of wood products.

ESTIMATING REGIONAL TIMBER PRODUCT CONSUMPTION

Derived Demand

The traditional approach to estimating timber demand assumes that demand equals the consumption of final timber products (Cardellichio and Veltkamp 1981). This "derived demand" approach will be used in this report. For simplicity and accuracy, however, demand will be referred to as "consumption." In effect, timber products will be traced through their various processing phases to the final or end-use markets in which they are consumed.

Definitions

Timber product categories are difficult to define because of the complex nature of product manufacturing. Mill residues from a sawmill, for example, may be shipped to a pulpmill for pulping. Are they a secondary product of the sawmill or a primary product for the pulpmill? For purposes of this report, primary timber products are defined as roundwood products such as pulpwood, saw logs, veneer logs, and fuelwood. Mill residues are also included since they re-enter the primary-mill processing stage. Like fuelwood, if residues are used as fuel, they are considered both a primary product and a final product.

Secondary timber products are any primary products that undergo further processing. This broad definition simplifies the complex of processes and products involved in timber product manufacturing. For reasons of practicality, however, it is necessary to limit the number of secondary products considered. Therefore, four more specific product classifications will represent secondary products: paper and board, lumber, particleboard, and plywood and veneer. Although these four product classifications may be relatively specific, problems with definitions remain. The most troublesome classification is particleboard. At times particleboard represents a broad range of products manufactured from wood particles, such as waferboard, oriented strand board, and medium-density fiberboard (USDA Forest Service 1982; U.S. Department of Commerce, Bureau of the Census, Census of Manufactures series). At other times it specifies a dry, reconstituted board product used for industrial purposes, primarily furniture manufacturing (Pennington 1984). For purposes of this report, the broad particleboard definition will be used for the classification. The narrow particleboard definition will represent one product within the classification. It will be called "industrial particleboard" as differentiated from the "structural particleboard" products in the classification (see Particleboard section).

Data Sources

The availability of data on the production and consumption of primary and secondary timber products varies among products. In general, the amount of available data is directly related to the perceived importance of the product to the region at a given time. For example, a very good data series has been maintained for pulpwood because of its significant contribution to the Lake States economy. By comparison, less data is available for veneer logs and saw logs because they hold less economic importance. In addition, data on saw logs is more difficult to obtain due to the large number of small mills that comprise the region's lumber industry.

There is generally more and better data available for primary timber products than for secondary timber products. The USDA Forest Service, North Central Forest Experiment Station (NCFES) has been conducting mill surveys for many years, often in conjunction with state forestry agencies. These surveys represent a reliable and fairly consistent data series for primary production and consumption.

By comparison, secondary product data comes from multiple sources, is laden with inconsistent industry and product definitions, and often has a questionable degree of reliability. The Bureau of the Census (U.S. Department of Commerce) and the USDA Forest Service are the major sources of secondary product data. However, trade organizations (e.g., the American Paper Institute, American Plywood Association, and National Particleboard Association), and private research organizations (e.g., Data Resources Incorporated, Stanford Research Institute, and Morgan Stanley & Company) also generate such data.

This report relies heavily on data gathered by the USDA Forest Service and Bureau of the Census. Since both of these sources present secondary data within the framework of the Standard Industrial Classification (SIC) system, they are relatively consistent. Although the best available, much of the USDA Forest Service and Bureau of the Census data is subject to large sampling errors and should be approached with some caution[2].

Product Flow Concepts

The flow of primary and secondary timber products can be very complex (fig. 1). Some primary products flow directly to end-use markets (e.g., fuelwood). Most products, however, receive further processing before they reach such markets. Imports and exports of various products occur along the flow, often in perplexing patterns. For example, softwood residues and woodpulp are imported for the region's pulp and paper industry while significant volumes of low-cost red pine remain unused in one part of the region and roundwood pulpwood is being exported from other parts. These patterns could probably be explained given information about transportation costs and trade relationships. Without such information, however, some import and export patterns remain enigmatic.

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[2]*The Bureau of the Census has been underestimating lumber production in the South for some time. This also appears to be true for the Lake States where lumber production estimates by the Bureau of the Census are as much as 25 percent lower than estimates by the North Central Forest Experiment Station for some years, (e.g., Michigan's 1977 lumber production was reported as 350 million board feet by the Bureau of the Census whereas the North Central Forest Experiment Station reported it as 457 million board feet).*

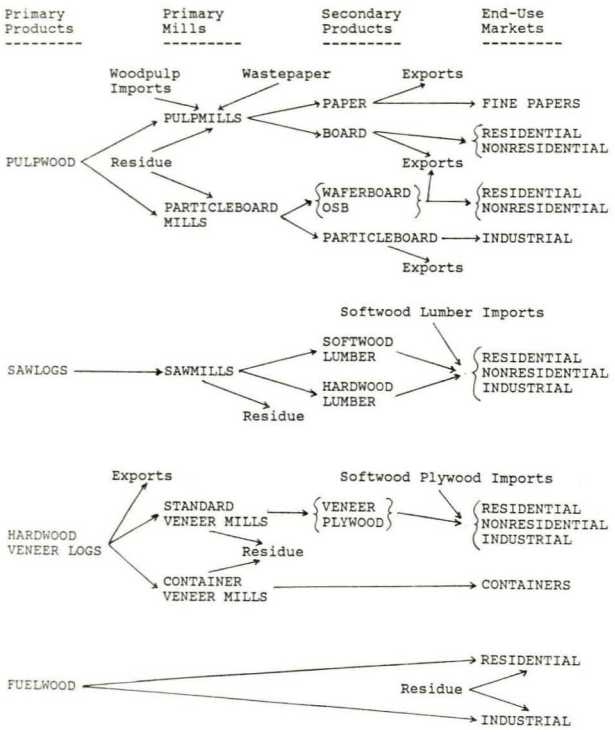

Figure 1.—*Primary and secondary wood product flows in the Lake States.*

Use-Factor Approach

As discussed previously, the demand for primary timber products is derived from the demand for secondary products, which is represented by secondary product consumption. Estimates of secondary product consumption in major end-use markets in the Lake States for this report were determined by the use-factor approach. This approach was first applied to wood product markets in the 1950's and has gained popularity due to advantages over traditional statistical analysis (Cardellichio and Veltkamp 1981).

The use-factor approach begins by identifying the major end-uses or individual markets in which a secondary product is consumed. Associated with each end-use is a "demand indicator" (i.e., an indicator of the level of market activity) and a "use-factor" (i.e., a measure of wood consumed per end-use unit). For example, the demand indicators and use-factors associated with each end-use market for lumber identified in the Lake States are presented in table 1. The product of the demand indicator and the use-factor associated with each market equals the lumber consumption in that market. The sum of the consumption in all markets estimates total lumber consumption in the Lake States.

Because the use-factor approach incorporates the results of major market surveys conducted by the USDA Forest Service, it provides detailed data about individual markets. Such detail, however, introduces some problems. Large sampling errors exist in some of the data and inconsistent industry and product definitions are sometimes difficult to reconcile (Cardellichio and Binkley 1984). As a result, different estimates of the same use-factor sometimes appear. For example, estimates of lumber-use per single-family home in 1977 by Spelter and Phelps (1984), the USDA Forest Service (1982), and Clephane (1982), were 11,970, 11,600, and 10,800 board feet per home, respectively.

Table 1.--Lumber market definitions

End-use market	Demand indicator	Use-factor
Residential construction	Single-family housing Multi-family housing Mobile home shipments	BF/sq. ft. of floor
	Additions & repairs (valuation)	BF/$1977
Nonresidential construction	Nonresidential buildings (valuation)	BF/$1977
Pallets	Pallet production	BF/pallet
Containers and dunnage	Index of all manufacturing (index, 1967 = 1)	BBF/index unit
Furniture	Furniture production index (index, 1967 = 1)	BBF/index unit
Other manufacturing	Index of all manufacturing (index, 1967 = 1)	BBF/index unit

(Adapted from Cardellichio and Binkley 1984.)

National use-factors were used in conjunction with Lake States demand indicators to derive estimates of secondary product consumption in this report. Appropriate state demand indicators were found for some end-use markets; for others, methods were developed to estimate regional shares of national demand indicators. Use-factors and demand indicators, where available, are presented in the appendices in association with the appropriate end-use markets. The use-factor approach was not used to estimate the consumption of paper and board because another per-capita consumption approach was deemed more suitable.

Successful application of the use-factor approach to the Lake States region implies two major assumptions. First, we assumed that the costs and technologies of end-use markets in the Lake States do not differ significantly from the costs and technologies of those same end-use markets in the nation as a whole. For example, this presumes that a hardwood pallet manufactured in the Lake States uses the same amount of hardwood lumber as the average hardwood pallet manufactured in the U.S., or that the amount of plywood used in the Lake States per dollar of expenditure in the residential alteration and repair market is the same as the average amount of plywood used per dollar of expenditure in the same end-use market nationally.

Second, we assumed that regional data sources can serve as demand indicators even though some are not directly comparable to the national demand indicators and others are estimates derived through regional share-analysis of national demand indicators. For example, shipments of mobile homes to the region are assumed to reflect mobile home production in the region. Also, pallet production is assumed to be a regional share of national production, since no regional data exists.

These two assumptions compound the problem of large sampling error which already exists in the national data for certain markets; however, the use-factor approach still provides a logical and informative method for estimating secondary product consumption. Moreover, new market information from surveys or knowledgeable individuals may easily be incorporated into the estimates. Therefore, the estimates can be considered to be as reliable as the best information available for any given market, and, in aggregate, as the sum of the best existing information.

PAPER AND BOARD

The paper and board industry in the Lake States began developing in the early 1900's and grew while the region's lumber industry declined[3]. Today it is the region's major wood products industry, employing over 100,000 workers and utilizing more than twice as much roundwood as all other regional wood products industries combined.

The Lake States paper industry has found an especially good market niche in the production of high-quality paper for writing, magazines and books (Lothner and Skok 1977). Domestic markets for such paper products have grown rapidly as personal disposable incomes have increased. Future prospects for growth appear strong both domestically and in export markets[4].

Paper production in the region increased from 2.8 million tons in 1960 to 4.2 million tons in 1975 while board production held relatively steady. The increasing ratio of paper to board production represents the rising significance of paper to the region. In 1977 the Lake States accounted for 16 percent of the nation's total paper production and claimed the nation's number one paper-producing state (Wisconsin).

Total paper and board production in the region rose from 4.9 million tons to 7.8 million tons between 1960 and 1980 while estimates of paper and board consumption during the same period rose from 3.3 to 5.5 million tons. The 1.5 to 2 million-ton gap between production and consumption represents net exports of paper and board to markets outside of the Lake States. Although not precisely known, these export markets are probably located in Midwest and Northeast publishing centers.

Woodpulp and Wastepaper

The manufacture of paper and board requires the consumption of fibrous material, generally in the form of woodpulp or waste-paper. In 1980, 38 woodpulp mills in the Lake States produced 3.5 million

[3]*Paper and board is defined to represent all grades of paper, all grades of paperboard, wet machine board, and construction paper and board, including insulation board and hardboard (U.S. Department of Commerce, Bureau of the Census, Current Industrial Report, Series M26A).*

[4]*United States exports of book paper and fine paper to Canada and Latin America have been increasing rapidly in recent years (USDA Forest Service 1982).*

form of woodpulp or waste-paper. In 1980, 38 woodpulp mills in the Lake States produced 3.5 million tons of woodpulp; an additional 1.7 million tons were imported to meet woodpulp requirements for that year (Blyth and Smith 1982). In total, an estimated 5.2 million tons of woodpulp plus 1.8 million tons of wastepaper were consumed by the region in the manufacture of 7.8 million tons of paper and board. The Lake States has relied upon significant woodpulp imports for at least the last 20 years, the majority of which originated in Canada.

Pulpwood

In 1982, 38 pulpmills and 8 particleboard mills received 5.66 million cords of pulpwood in the form of roundwood or residue (Blyth and Smith 1984a)[5]. Of this total, 5.52 million cords were produced in the Lake States; the remaining volume (mostly softwood residues) was imported from other states (primarily western states) and Canada[6].

Pulpwood receipts by Lake States mills consistently exceeded pulpwood production between 1960 and 1980, although the gap narrowed in the latter years. The composition of the region's imports, however, changed during this period. In the earlier years, roundwood pulpwood accounted for the majority while in the latter years residues comprised virtually all of the imports. The source of these imports also changed during the period. In the earlier years, the majority came from Canada whereas western states (e.g., South Dakota and Wyoming) provided most imports in the latter years.

The reliance on pulpwood imports, although diminishing in recent years, could represent a concern to the Lake States, particularly Wisconsin. If the supply of softwood residues from the West were to diminish with the advent of more efficient sawmill techniques and reduced lumber production, Lake States pulpmills would have to seek new softwood sources, or perhaps hardwood substitutes, in order to meet their requirements. Whether the forests of the region can physically produce such increases at competitive prices is subject to speculation.

[5]*Particleboard mills are defined as those manufacturing industrial particleboard, waferboard, oriented strand board and other composition boards.*

[6]*For simplicity, it is assumed that pulpwood exports from the Lake States are insignificant. Thus, poulpwood receipts by Lake States' mills minus pulpwood production within the region represents net pulpwood imports.*

Aspen is the region's key pulpwood species, although there is a significant upward trend in production and mill receipts of other hardwoods such as paper birch, hard and soft maple and red oak. The region produces all of the hardwood roundwood it uses as pulpwood. For many of the last twenty years, softwood roundwood has been imported, although such imports appear to be declining. Ponderosa pine from western states and jack pine from Canada have been the significant "hard pine" imports, while Canadian spruce has been the major "other softwood" import. In recent years, Lake States production of both hard pine and other softwoods has surpassed mill receipts in the region. However, hard pine receipts have continued to rise while other softwood receipts appear to be declining, suggesting a regional preference for the former.

Particleboard Effect

The eight particleboard mills active in the region used 675 thousand cords of pulpwood (mostly aspen) in 1982 for the production of 780 million square feet of particleboard (Blyth and Smith 1984a)[7]. The growth of the particleboard industry, primarily structural particleboard (e.g., waferboard and oriented strand board), has been dramatic in the past five years. In 1983, Lake States mills became the leading producers of waferboard and oriented strand board in the nation and in the world. The industry's future appears bright, although questions remain about the ability of Lake States forests, especially aspen resources, to sustain continued growth in the particleboard industry as well as the paper and board industry.

Future Consumption and Exports

The future consumption of Lake States paper and board products will depend upon trends in national and international markets as well as the ability of the Lake States to compete with other regions in providing these products. Assumptions about population growth, economic activity and the character of the region's timber resources and industry become critical. In general, national and international markets for high-quality paper are expected to continue

[7]*Particleboard pulpwood requirements have been included in pulpwood data since 1979 (Blyth and Smith 1981). Therefore, an adjustment must be made to determine the amount of pulpwood produced strictly for pulpmills. In 1982, the revised pulpwood receipts at pulpmills would be approximately 5 million cords; almost the entire reduction would be composed of aspen receipts.*

growing at rates several points above the Gross National Product (Pulp and Paper 1982). The potential for Lake States paper production to grow with these markets appears to be great. Prospects for competing with other regions in the nation also appear good. Although the region's paper and board industry significantly depends on imports of both woodpulp and softwood residue and faces increasing competition from the particleboard industry for the aspen resource, several factors support the assumption that the industry will continue to grow and be in a favorable position to compete with other regions:

- Relative proximity to publishing centers in the Midwest and Northeast and to international ports;
- Extensive 38-mill infrastructure in a capital intensive industry;
- Stumpage costs representing only a small percentage of the selling price of paper and board products, i.e., rising stumpage prices have relatively little effect on stumpage demand;
- History of cost-saving technical improvements at all levels of processing, as exemplified by the increased use of low-cost hardwoods; and
- Vast timber resource base with a significant potential for gains in productivity.

LUMBER

During the late 19th century, the Lake States led the nation in lumber production. White pine, red pine, and other softwoods were the dominant species. After steady decline to the 1930's, the region's lumber industry began to grow once more. This time, however, production consisted primarily of hardwoods, since the Lake States "second forest" was a hardwood forest. Of the 889 primary wood-using mills in the Lake States in 1975, 775 were sawmills most of which were small (i.e., they used only half as much roundwood as the region's 41 active pulpmills) (Blyth *et al*. 1980). Saw log production has been increasing in recent years, and, as more of the region's poletimber moves into the sawtimber size class, production should continue to rise. Lumber consumption in the region, however, will largely determine the level of saw log production.

Lumber Consumption and Production

More than 1.5 billion board feet of softwood lumber and nearly 0.8 billion board feet of hardwood lumber are consumed in the region's major end-use markets each year (table 2) (Spelter and Phelps)[8].

Table 2.--Lake States lumber consumption by end use

(In million board feet)

	1973	1977	1981
Softwoods			
Residential			
Single-family	974.8	1,071.5	329.9
Multi-family	269.8	206.2	87.6
Mobile homes	82.4	47.1	32.9
Alterations and repairs	NA	NA	63.3
Nonresidential buildings	NA	NA	63.4
Industrial			
Pallets	124.0	150.4	153.0
Containers and dunnage	102.5	70.2	69.6
Furniture	108.9	139.5	158.7
Other mfg.	114.5	117.7	125.2
Total	1,776.9	1,802.6	1,083.6
Hardwoods			
Residential			
Single-family	41.8	38.3	12.0
Multi-family	4.9	3.0	.8
Mobile homes	3.4	1.8	1.2
Nonresidential buildings	NA	NA	10.6
Industrial			
Pallets	310.0	355.0	384.0
Containers and dunnage	119.6	111.3	117.3
Furniture	203.4	203.8	211.6
Other mfg.	63.3	54.0	54.6
Total	746.4	767.2	792.1

Softwood lumber consumption depends upon residential construction markets, primarily single-family home construction. It is therefore subject to great fluctuation, such as the 40 percent decline seen during the 1981 building recession. Hardwood lumber consumption, on the other hand, depends on industrial markets which have shown steady growth. Pallet manufacturing represents about one-half of the region's industrial wood consumption.

Consumption estimates are more reliable for some markets than others because of statistical errors in the national use-factor estimates and the method of applying use-factors to the region. Estimates of lumber consumption in single- and multi-family home construction, for example, are relatively secure because both the national use-factors and the regional

[8]*Spelter and Phelps (1984) estimate that the end-use markets included here represent about 75 percent of total softwood lumber consumption and 85 percent of total hardwood lumber consumption in the nation. Because it is reasonable to assume that similar proportions apply for the region, consumption estimates for the region probably understate actual consumption.*

data to which they were applied are fairly reliable. Lumber-use estimates in alteration and repair markets, on the other hand, may be questionable because national use-factor estimates have a high degree of uncertainty and regional share estimates had to be developed in order to apply national use-factors.

Lumber consumption estimates for industrial end-use markets are subject to considerable uncertainty as well, primarily because of the need to estimate regional shares of national manufacturing. Inconsistent industry and product definitions also introduce error into regional estimates of individual markets. When individual market estimates are aggregated, however, the errors are probably reduced.

Hardwood lumber production in the region roughly equals consumption, whereas softwood lumber production represents only a small portion (10 to 15 percent) of total regional consumption in the region. This suggests that hardwood lumber consumed in the region is largely produced by Lake States sawmills. Softwood lumber consumed in the region, on the other hand, is composed primarily of imports from Canada and from southern and western states.

Saw Logs

In 1980, the Lake States produced more than 1.1 billion board feet of saw logs, three-quarters of which was hardwoods. Aspen was the dominant species with red oak and hard maple being significant other species. Aspen was used primarily in pallets, furniture, containers and construction, while red oak and hard maple were important species for furniture, flooring, railroad ties, and pallets. Less than one percent of the region's saw log production is exported, although some saw log shipments occur among the region's states. Michigan is the region's largest saw log producer with Wisconsin a close second. Wisconsin, however, exhibits the greatest volumes delivered to mills in the region. This is explained by saw log imports from Michigan's western upper peninsula as well as a smaller number of imports from Minnesota. Saw log imports to the Lake States, like exports, are insignificant.

Future Consumption

Since World War II, more efficient manufacture and use of lumber and the substitution of plywood and particleboard panels for various lumber products have resulted in a decline in lumber-use by end-product within the Lake States region. Residential construction, traditionally the largest end-use for lumber, has, for example, been affected by three key developments (Spelter and Phelps 1984):

- More efficient utilization of lumber framing;
- Substitution of plywood for boards in sheathing;
- Trend toward basementless homes.

Regional growth in residential and industrial end-use markets for lumber will largely determine future lumber consumption by the region. Although the region's growth rate is expected to be lower than the national average, it is still projected at about 7 percent for the 1980-1990 period (Jackson and Masnick 1983; U.S. Department of Commerce, Bureau of Industrial Economics 1983). Such growth would result in substantial increases in lumber consumption within the region.

The Lake States ability to compete with other regions serving national and regional lumber markets will depend heavily on relative stumpage prices. Projections suggest that rising softwood stumpage prices in the U.S., relative to those in Canada, will result in increased imports of Canadian softwood lumber, especially in the Northeast and North Central regions (USDA Forest Service 1982). This scenario is expected to prevail until Canadian timber resources begin to decline in quality and increase in distance from the mills. Given such circumstances, inroads into softwood lumber markets may be difficult for Lake States softwood lumber producers. There is also some question as to whether adequate volumes of softwood saw logs will exist in the region to provide for a competitive softwood lumber industry. Opportunities may exist, however, for Lake States hardwoods to compete in traditional softwood markets. Recent advances in sawing and drying techniques have made feasible the production of construction grade lumber from some lighter hardwood species, such as aspen and yellow poplar (Spelter and Phelps 1984).

As the Lake States forests mature, a growing proportion of the timber will move into the sawtimber size class. Since the majority of this sawtimber will be hardwoods, it appears that the greatest opportunity for the region may be to increase production of hardwood lumber in order to meet the growing requirements in industrial end-use markets. Hardwood lumber production nationwide is projected to increase steadily between 1985 and 1990 by more than 3 percent per year (USDA Forest Service 1982). As long as hardwood stumpage prices in the region do not rise relative to other regions, the Lake States hardwood lumber industry should be able to maintain its market share within regional markets and

thus grow with these markets. Operators of the region's numerous small sawmills, however, will need to stay abreast of the changing technologies and of the product characteristics that lumber-users desire in order to maintain their market share.

PLYWOOD AND VENEER

Veneer logs used in the manufacture of plywood and veneer represent the third most valuable timber product in the Lake States, behind pulpwood and saw logs. Because veneer logs are almost exclusively hardwoods, the region's plywood and veneer industry is essentially a hardwood industry. In addition, more than 90 percent of the veneer logs produced in the region are standard veneer logs (i.e., used in doors, furniture, wall panels, exterior sheathing, and similar items); the remainder is container veneer logs (i.e., used in boxes, crates, packing cases and other containers).

The region's plywood and veneer industry declined between 1950 and 1970, due largely to a decline in Wisconsin's industry (Blyth and Smith 1984b). Since 1970, however, the region's industry has grown, primarily due to growth in Michigan. Future prospects depend upon the industry's ability to compete with other structural panels such as waferboard and oriented strand board in residential and nonresidential construction markets and the industry's adoption of technologies necessary to compete in veneer export markets.

Plywood and Veneer Consumption and Production

Plywood and veneer consumption in the region's major end-use markets totaled 608 million square feet in 1981 (table 3). Residential markets generally represent about half of the region's consumption, with furniture manufacturing constituting the most significant industrial use. Consumption of plywood and veneer in the region is five times greater than regional production. More than 500 million square feet of plywood and veneer is imported into the region each year. These imports consist mostly of softwood plywood from Canada and from western and southern states. Because the hardwood plywood and veneer industry relies more on nonresidential construction markets (e.g., office buildings) than residential markets, production in the Lake States dropped less severely during the 1980 building recession than total plywood and veneer consumption in the region (Stier 1984).

3.--Lake States plywood and veneer consumption by end use

(In million square feet, 3/8-inch basis)

End-use market	1973	1977	1981
Residential			
Single-family	467.2	539.5	201.5
Multi-family	145.0	133.6	59.3
Mobile homes	56.6	28.9	20.9
Alterations and repairs	NA	NA	33.9
Nonresidential buildings	NA	NA	55.5
Industrial			
Pallets	41.9	66.8	85.2
Containers and dunnage	40.8	36.2	34.6
Furniture	89.4	102.4	117.0
Total	840.9	907.4	607.9

Veneer Logs

Veneer log production increased and surpassed receipts in the region during the last two decades. Imports have fallen and exports risen sufficiently to shift the region from a net importer to net exporter. Imports from Canada fell most dramatically (7 million to 0.5 million board feet) although imports from other states (e.g., Iowa, Illinois, and Indiana) showed significant declines as well (5.4 million to 1.6 million board feet). The region's exports are shipped to Indiana, Ohio, and Kentucky and to other countries such as Canada and West Germany.

Twenty-eight plywood and veneer mills were active in the Lake States in 1980. Although the majority were located in Wisconsin, Michigan mills received nearly the same volume—about 27 million board feet (Blyth and Smith 1984b). Wisconsin's plywood and veneer industry gradually declined over the last two decades whereas Michigan's industry showed a sudden growth. A similar but less dramatic pattern occurred for veneer log production in Wisconsin and Michigan. Minnesota's veneer log production declined slightly during this period, although receipts increased substantially in 1980. Both Michigan and Minnesota are net exporters of veneer logs, while Wisconsin is a net importer.

Aspen is the most significant veneer log species in the Lake States, although twenty years ago it was insignificant. Other major veneer log species include hard maple, red oak and yellow birch. Because aspen veneer log production equals consumption, exports from the region are composed of other hardwood species.

Future Consumption and Exports

Although hardwood plywood and veneer products are expected to lose some market share to waferboard and oriented strand board products, growth in construction and industrial markets should be sufficient to generate a net increase in plywood and veneer consumption. Furthermore, waferboard and oriented strand board are expected to compete more with softwood plywood than hardwood plywood and veneer, so domestic markets should show steadier growth for hardwood plywood and veneer than for softwood plywood. Production of hardwood plywood and veneer nationwide is projected to grow at an average rate of nearly 6 percent per year between 1985 and 1990 whereas softwood plywood production is expected to grow at less than 3 percent per year during the same period (USDA Forest Service 1982).

Export markets for plywood and veneer products manufactured in the Lake States show substantial promise, especially European markets (Stier 1984). Although more than one-half of all veneer produced in the U.S. in 1979 was exported, mostly to Europe, Lake States mills have been slow to make the changes necessary to compete in these export markets. In fact most new and efficient veneer mills in the United States are owned by European capitalists (Stier 1984). New capital investment, the adoption of new production techniques and aggressive marketing will probably be needed if the Lake States region is to expand exports to European markets.

Increases in veneer log production and the region's emergence as a net exporter of veneer logs are trends consistent with the maturing of the region's timber resources. The plywood and veneer industry, however, requires high-quality hardwoods; some producers are concerned that although growing-stock trees may be getting larger, quality veneer logs may not be available in the future. The industry also may be troubled by a possible regional reorientation toward fiber production rather than larger timber products.

PARTICLEBOARD

In 1983, the Lake States region secured the position of being the world's leading producer of structural particleboard. Regional production in that year exceeded one billion square feet, a quantity that, for the first time, surpassed Canadian production. Although nationwide production of structural particleboard is expected to increase dramatically over the next 5 to 10 years (especially in the Southeastern United States), Lake States leadership should continue given growth in the region's construction and industrial markets and great opportunity to serve markets in foreign countries (Anderson 1984).

Particleboard is composed of a number of products, each of which adds to confusion over an appropriate definition for "particleboard." For purposes here, particleboard is defined as follows:

- Industrial particleboard—the first of the dry, reconstituted board products introduced, plus medium density fiberboard. These products are generally consumed in industrial uses (e.g., furniture manufacturing).
- Structural particleboard—reconstituted board products (e.g., waferboard, oriented strand board, composite plywood) which generally compete with softwood plywood in construction markets.

Particleboard Consumption and Production

Particleboard consumption within the Lake States probably exceeds 200 million square feet. This estimate assumes that residential construction markets account for about one-half of all particleboard consumption (Pennington 1984). Table 4 does not include estimates of particleboard consumed in several important markets (e.g., residential alterations and repairs, pallets and containers) because national end-use factors, on which to base regional consumption estimates, do not exist.

Particleboard production has grown significantly in the Lake States, especially since 1980. Structural particleboard, for example, grew from approximately 150 million square feet in 1980 to over one billion square feet in 1983. The majority of this growth (70 percent) occurred in Minnesota. The region's capacity to produce industrial particleboard has also increased but at a more moderate rate. In 1982, total regional production of particleboard (structrual and industrial) was nearly one billion square feet and required the use of 675 thousand cords of pulpwood, mostly aspen.

Table 4.--Lake States particleboard consumption by end use

(In million square feet, 3/8-inch basis)

End-Use Market	1973	1977	1981
Residential			
Single-family	49.2	69.8	35.8
Multi-family	9.8	9.8	6.2
Mobile homes	55.4	30.0	19.2
Industrial			
furniture	20.6	29.6	34.8
Total	135.0	139.2	96.0

Lake States regional exports of particleboard are substantial. In 1983, they probably exceeded 1.3 billion square feet. Large midwestern residential and industrial markets (e.g., Chicago, St. Louis) are very likely the major recipients of these exports. High transportation costs associated with the heavy weight of particleboard may well be curbing the use of Lake States particleboard in more distant markets.

Future Consumption and Exports

The American Plywood Association projects waferboard and oriented strand board production to nearly triple between 1984 and 1990. Two trends supporting this contention are:

- Increases in the average volume of particleboard used per new residential unit; and
- Increased penetration of markets other than residential construction markets (e.g., residential alterations and repairs, nonresidential construction) which grew to 60 percent of total particleboard consumption in 1983 (Pease 1984).

Export markets, particularly in Europe, also represent an opportunity for the structural particleboard industry (Anderson 1984). Future increases in the use of particleboard will depend largely on the industry's ability to maintain low product prices relative to softwood plywood (Spelter 1984).

Major structural-particleboard mill construction programs have been undertaken by U.S. wood-based corporations (e.g., Louisiana-Pacific Corporation and Georgia-Pacific Corporation). Low-cost timber resources seem to be the determining factor in locating mills (Pease 1984). As the industry grows within a region, intensifying competition for timber resources may entail increasing stumpage prices which, in turn, could shift future industry expansion to other regions (Seale and Lyon 1984). In the short run, however, Southern U.S. mills will probably serve rapidly expanding markets in the Sunbelt, while Lake States mills will continue to serve growing Midwestern markets.

The rapid growth of Lake States waferboard and oriented strand board production in the Lake States has raised concern about the adequacy of the region's timber resources, particularly aspen. Concern focuses on meeting the raw material requirements of the particleboard industry as well as the paper and board industry. Hardwoods other than aspen will probably have to satisfy a greater proportion of these future requirements. Oriented strand board production may increase in the region relative to waferboard production since it requires less aspen than the latter (Pennington 1984).

FUELWOOD

Wood was the primary source of energy in the U.S. during the late 1800's and remained a major source of residential heat until the 1930's. As fossil fuels became popular, wood used for fuel declined until the 1970's when fossil fuel prices began to rise. Between 1974 and 1981, the use of wood fuels in the U.S. rose by 45 percent, due to increases in both residential and industrial use (Blyth *et al.* 1984).

Fuelwood Consumption

Residential consumption of fuelwood in the Lake States in 1980 was about 4.4 million cords. Only about one-fifth of the urban households (i.e., those located in villages and cities of 2,500 people or more) used wood for fuel, compared to nearly one-half of the rural households. Also, urban households, on average, burned only 1.6 cords in that year whereas rural households burned 3.1 cords (Skog and Watterson 1984). Since then, residential fuelwood consumption has grown significantly, as indicated by 45 and 75 percent increases in Michigan and Wisconsin, respectively, between 1980 and 1981. A slowing trend, however, may be seen between 1981 and 1982 in Michigan where residential fuelwood consumption increased by only 10 percent. This was probably due to a declining rate in the number of homes converting to fuelwood as a major heating source.

Industrial use of fuelwood in the region is also increasing and should continue to rise as the relative costs of alternative fuels rise. In 1981, about 40 percent of all primary wood-using mill residues produced in Wisconsin, or about 250 thousand tons of residue, were consumed as fuel. About three-fifths were used by industrial consumers while the remainder went to residential consumers. Since all primary wood-using mill residues in Wisconsin are currently being consumed, as fuel or in other wood product manufacturing, increased industrial use of fuelwood will result either directly or indirectly in expanded use of logging residue, such as tops and limbs, imports of residues, or increased roundwood harvesting (Blyth *et al.* 1984).

Michigan and Minnesota both consume considerably less primary wood-using mill residue than they generate (Michigan DNR 1979; Minnesota DNR 1983). Thus, sufficient residue is available for increased industrial fuelwood use in the near future.

Indeed, Minnesota forestry officials consider excess primary wood-using mill residue plus the State's considerable logging residue a significant resource for energy purposes (Minnesota DNR 1983).

Fuelwood Production

The region's only intensive survey of fuelwood production was completed in 1981 in Wisconsin (Blyth *et al*. 1984). Nearly 90 percent of the fuelwood consumed in the State was produced from roundwood. Households dominated this production, producing 7 out of every 8 cords. In the more heavily forested areas of the north, however, loggers harvested 1 out of every 4 cords. Private rural woodland was the major source of fuelwood in Wisconsin, providing more than 90 percent of the State's overall production. However, in the northern portions of the State public lands provided about one-fourth of the fuelwood harvest. Nongrowing stock on commercial forest land (e.g., dead trees, cull trees, tops and limbs) provided more than 60 percent of the fuelwood harvest. Growing-stock accounted for only 15 percent overall, although it represented between 20 and 24 percent of production in the States northern area. Hardwoods represented 96 percent of Wisconsin's fuelwood harvest. Red oak and elm were the dominant species; hard maple, white oak, aspen, white birch, and ash were also significant contributors.

Future Consumption and Exports

Future growth or decline in residential fuelwood consumption in the Lake States will depend largely on the price of wood fuels relative to alternative fuels. Rural households will probably use notably more fuelwood if prices of alternative fuels rise; urban households, however, may not increase fuelwood use as significantly since they face higher dollar costs and greater inconveniences in using wood fuels (Skog and Watterson 1984). Industrial consumption is expected to increase also, as the relative price and environmental advantages of fuelwood become more pronounced. Primary wood-using residue and logging residue will probably provide for some of this increased consumption over the short run; in the long run, however, an increasing proportion will probably come from roundwood. More efficient logging and sawing techniques will probably result in lower rates of residue production, and competition for residue between fuelwood and other products will probably increase.

In 1981 about 15 percent of all roundwood harvested in Wisconsin came from growing stock on commercial forest land. In volume, this represented enough roundwood to supply one 500 ton-per-day pulpmill for one year (Blyth *et al*. 1984). Assuming that this 15 percent ratio applied to each of the Lake States, growing stock harvested for fuelwood in the region represented the annual requirements of more than three 500 ton-per-day pulpmills. Currently, this volume is relatively insignificant. As fuelwood consumption increases, however, it may infringe upon the growing pulpwood requirements of the paper and board and particleboard industries. This may result in upward price pressures for hardwoods in the North Central Region (USDA Forest Service 1984).

SUMMARY AND CONCLUSIONS

The Lake States forest represents an important economic resource which holds promise for relieving some of the region's economic woes. Forest resource managers and planners are searching for appropriate strategies to encourage growth in the region's wood products economy while also ensuring long-term timber supply.

Timber Resources

Forty-five million acres of commercial forest land comprise the Lake States forest. Nearly half is publicly owned, with state and county ownership accounting for about 26 percent. This high proportion of non-federal public ownership represents an opportunity, unique to the Lake States, for state and local governments to have a major influence on the future of the region's forest.

Aspen-birch is the dominant forest type in the region (32 percent coverage of the commercial forest land) with maple-beech-birch and spruce-fir types following in importance (24 percent and 15 percent coverage, respectively). Oak-hickory, white-red-jack pine and elm-ash-cottonwood types account for the remainder.

The Lake States is the nation's only region in which pole-size timber predominates, covering 45 percent of the commercial forest land. The preponderance of 40 to 60 year old aspen and birch partially explains this unique characteristic. It also accounts for the skewed age-class distribution evident in the region. This "wall of wood" phenomenon raises important questions about the utilization of the exist-

ing timber resource and the achievement of the forest's productive capability.

Hardwoods account for three-quarters of the region's growing-stock volume. Despite an eight percent decline in commercial forest land over the last two decades, growing-stock volumes of hardwoods and softwoods have increased substantially. For most species, growth has exceeded removals by a significant margin. The productive-potential of the Lake States forest is low relative to other regions; however, the region has a greater opportunity than many others to improve upon its current productivity.

Prospects for the development of the Lake States forest are better today than in the past (Shands and Dawson 1984). Advances in technology have effectively transformed the region's pole-size hardwoods into a fiber resource, highly desirable for paper and board products and for structural particleboard products such as waferboard and oriented strand board.

Paper and Board

In recent years, the region's paper and board industry has increased production of paper relative to board. As a result, the Lake States has become one of the largest paper-producing regions in the country, accounting for 16 percent of the nation's total production in 1977. The region is a significant net exporter, specializing in the production of fine writing, book and magazine papers. Domestic and international markets for such products show strong growth potential and Lake States producers appear to be well-situated to compete in these markets. However, two major issues face the industry: a significant dependency on imports of woodpulp and softwood residue and increasing competition for roundwood, primarily aspen.

Lumber

The Lake States lumber industry is characterized by a large number of small sawmills which, in aggregate, use about half as much roundwood as the paper and board industry. Hardwoods, primarily aspen, red oak, and hard maple, account for three-quarters of the region's production. Hardwood lumber is largely consumed in the manufacture of pallets, containers, and furniture (industrial end-use markets), while softwood lumber is consumed in residential and nonresidential construction markets. The region's production of hardwood lumber nearly equals regional consumption. Softwood lumber production, however, represents only a small portion of regional consumption. Thus, significant volumes of softwood lumber are imported from Canada and from southern and western states. As long as hardwood stumpage prices in the region do not rise relative to other regions, the hardwood lumber industry should be able to maintain its market share within the region's industrial end-use markets and grow with these markets. Furthermore, recent advances in sawing and drying techniques may create opportunities for hardwood lumber to compete in traditional softwood markets.

Plywood and Veneer

The plywood and veneer industry in the region is essentially a hardwood industry which produces standard veneer logs used in doors, furniture, wall panels, exterior sheathing, and similar items. The industry declined steadily between 1950 and 1970, after which it began to grow. Due to increasing production, the region has become a net exporter of veneer logs. Aspen is the most significant veneer-log species; other species (e.g., hard maple, red oak, and yellow birch) account largely for the region's exports. Hardwood plywood and veneer consumption is relatively insignificant when compared to softwood plywood consumption. Thus, although the region is a net exporter of hardwood plywood and veneer, it imports tremendous volumes of softwood plywood. As a result, total plywood and veneer consumption in the region is five times greater than regional production. Hardwood plywood and veneer is expected to lose some market share to structural particleboard products; however, these relatively new products compete primarily with softwood plywood in residential construction markets. Therefore, markets for hardwood plywood and veneer should show steadier growth than softwood plywood markets. Furthermore, international markets, especially Europe, represent significant opportunities for exports of high-quality hardwood veneer.

Particleboard

The Lake States region is one of the world's leading producers of structural particleboard (e.g., waferboard and oriented strand board). It also produces significant volumes of industrial particleboard. Total particleboard production in the region exceeds regional consumption by more than 1.3 billion square feet. Regional exports probably go to residential and industrial markets in the Midwest. Although structural particleboard production is

expected to increase dramatically in the South, such production will probably serve expanding Southern markets. As long as Lake States producers can maintain competitive prices, they should be able to maintain or increase their share in Midwestern markets. They are also favorably located to compete in export markets, especially in Europe, which are expected to expand once the product gains acceptance. Increasing competition for aspen, the industry's primary roundwood requirement, is a major concern.

Fuelwood

Residential fuelwood consumption in the Lake States was 4.4 million cords in 1980 and has grown significantly since then. Rural households are much more likely than urban households to use wood for fuel and burn nearly twice as much wood per household. Industrial consumption of fuelwood has also been increasing in the region as the relative prices of alternative fuels have risen. Private rural woodland represents the major source of fuelwood in the entire region; however, public forest land contributes about 25 percent in the region's northern portion. Similarly, growing-stock trees provide only about 15 percent of all fuelwood produced in the region, but in the northern portion their share approaches 25 percent. Future growth in residential and industrial fuelwood consumption will depend largely or the price of wood relative to alternative fuel prices. Increasing regional use of wood for fuel may result in upward price pressures for hardwoods.

Policy Implications

Assuming that end-use markets for secondary wood products expand as projected (USDA Forest Service 1982), Lake States regional timber production will probably increase, thereby resulting in greater competition for the region's timber resource. Competition for raw materials appears inevitable between the paper and board industry and the structural particleboard industry: both face strong growth prospects and rely significantly upon aspen. Furthermore, rapid increases in consumption of wood for fuel seem likely to intensify such competition.

A recent study of pulpwood, saw log, and fuelwood consumption in northeastern Minnesota estimated that total timber requirements in 2030 would exceed timber growth, based on current growth levels (Rockel *et al*. 1983). Future requirements for aspen were estimated to exceed aspen growth by a much greater margin. These findings can probably be generalized to the Lake States region; however, a broad array of factors will influence the future of the region's forest and different assumptions can lead to markedly different results (Adams and Haynes 1985). Among factors important to the region's forestry sector, other than traditional ones of population growth, general levels of economic activity and forest management intensity, are:

- Expansion of export trade;
- Increased use of low-quality hardwoods other than aspen in the product-species mix;
- Growing consumption of wood for energy;
- Improvements in wood utilization, both in logging and manufacturing; and
- Shifting stumpage prices in other regions of the United States and Canada with respect to those in the Lake States.

Forest resource managers and planners may have difficulty anticipating the effects of these factors, especially in the distant future. They can, however, assess the region's strengths and weaknesses, many of which have been identified here, and subsequently, take steps that will enable the region to capitalize upon opportunities as well as minimize the effects of threats.

Increased cooperation among the three states appears to hold significant potential benefits for the region. Coordination of certain forest policies and programs, for example, could enhance wood products trade between the states, resulting in improved utilization of the region's timber resource and a reduced dependency on imports. Improved systems of information exchange and the revision or elimination of laws and regulations which impede wood products trade represent initial steps toward achieving such objectives.

A positive regional forestry image also may benefit the region's wood producing and manufacturing sector. It could serve as the basis of both a campaign to promote the region's forestry opportunities among policy-makers at the national and regional levels and a marketing strategy to attract new wood products industry investment to the Lake States rather than other regions. Cooperation is the key to successfully developing such a regional image.

Research and Information Needs

The process of systematically gathering and organizing information about the production and consumption of major wood products in the Lake States

demonstrates our limited knowledge of the region's wood products trade. Further research is needed in a number of areas to reduce the uncertainty and improve our understanding. Three areas appear to warrant the greatest attention:

- Wood product flows and market structure. Without better information about the markets to which Lake States wood products flow and reasons for the development of such trade patterns, it is extremely difficult to assess opportunities and design strategies for further development of regional wood products industries. A well-designed survey of regional wood products producers, wholesalers and retailers could obtain such information. Current directories of primary and secondary wood-using mills are available for each state to assist in such a survey (Michigan DNR 1985; Milton and Krantz 1982; Wisconsin DNR 1982a, 1982b). Also, utilization and marketing specialists in each state could probably provide valuable information.
- Regional wood product prices. Wood product prices in Midwestern markets hold important implications about the competitive position of Lake States wood products industries with respect to such industries in other regions. A study of comparative prices for wood products from competing regions (e.g., the Lake States, the South, Canada) could provide useful information to assess the potential for expanding the market share of Lake States industries in major Midwestern wood products markets.
- Regional forest policies. A systematic identification of regional forest policies (local, state, federal) which affect investment and trade by wood products industries is needed to assess opportunities for improving the environment for such activities. A comparison of Lake States policies with those in other regions could be useful for determining the region's policy strengths and weaknesses.

During the course of this review, the statistical evidence on wood product production and consumption often proved to be lacking, outdated or inconsistent between states. Some of the more critical information needs are as follows:

- Timber inventory data by state for comparable periods of time.
- State or regional consumption, import and export data for paper and board products.
- State or regional import and export data for woodpulp.
- Separate reports for pulpwood used in particleboard production as opposed to paper and board production.
- More regular and reliable reporting of lumber production by state.
- Saw log production, import and export data by state for comparable years.
- Hardwood plywood and veneer production, import and export data for the region.
- Consistent particleboard product definitions.
- State or regional production, consumption, import and export data for defined particleboard products.
- Residential and industrial fuelwood production and consumption data by state.
- Regional use-factors for major wood products in major end-use markets
- Single- and multi-family housing starts by state.
- Mobile home production by state.
- Expenditures on residential alterations and repairs by state.
- State or regional pallet production.
- State or regional furniture production indexes.

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GLOSSARY

Commercial forest land.—Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization.

Composite plywood (COM-PLY).—A structural panel that combines a reconstituted board core with a veneer cover top and bottom.

Demand indicator.—(See Use-factor approach.)

Diameter classes.—A classification of trees based on diameter outside bark, measured at breast height (4.5 feet above the ground).

End-use market.—(See Use-factor approach.)

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use.

Forest site productivity class.—A classification of forest land in terms of potential cubic-foot volume

growth per acre at culmination of mean annual increment in fully stocked natural stands.

Forest type.—A classification of forest land based upon the tree species forming a plurality of the stocking.

White-red-jack pine.—Forests in which eastern white, red pine, or jack pine, singly or in combination, comprise a plurality of the stocking.

Spruce-fir.—Forests in which spruce or true firs, singly or in combination, comprise a plurality of the stocking.

Oak-hickory.—Forests in which upland oaks, or hickory, singly or in combination, comprise a plurality of the stocking.

Elm-ash-cottonwood.—Forests in which elm, ash, or cottonwood, singly or in combination, comprise a plurality of the stocking.

Maple-beech-birch.—Forests in which maple, beech, or yellow birch, singly or in combination, comprise a plurality of the stocking.

Aspen-birch.—Forests in which aspen, balsam poplar, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking.

Growing-stock trees.—Live sawtimber trees, poletimber trees, saplings, and seedlings meeting specified standards of quality or vigor; excludes cull trees.

Growing-stock volume.—Net volume in cubic feet of live sawtimber and poletimber trees from stump to a minimum 4-inch top (of central stem) outside bark or to the point where central stem breaks into limbs.

Growth.—(See Net annual growth.)

Hard pine.—Includes red pine and jack pine.

Logging residue.—The unused portions of poletimber and sawtimber trees cut or killed by logging.

Medium-density fiberboard (MDF).—Combines technologies of hardboard and early industrial particleboard to create new panel product for furniture manufacturers.

Net annual growth.—The net increase in the volume of trees during a specified year. Components of net annual growth include the increment in net volume of trees at the beginning of the specific year surviving to its end, plus the net volume of trees reaching the minimum size class during the year, minus the volume of trees that died during the year, and minus the net volume of trees that became rough or rotten during the year.

Nonforest land.—Land that has never supported forests and land formerly forested where use of timber management is precluded by development for other uses.

Nonstocked areas.—Commercial forest land less than 10 percent stocked with growing-stock trees.

Other hardwoods.—Includes all hardwoods other than aspen.

Other softwoods.—Includes all softwoods other than hard pine, i.e., red pine and jack pine.

Oriented strand board (OSB).—A reconstituted board product which attempts to duplicate the physical properties of plywood through orientation of the wood particles or strands.

Particleboard.—Reconstituted board products manufactured by reducing solid wood to smaller components (i.e., particles, fibers, strands, flakes, wafers, etc.) and then gluing the small components back together again into a usable board product.

Structural particleboard.—Generally includes waferboard, OSB, and composite plywood or comply. These products compete primarily with softwood plywood in construction markets.

Industrial particleboard.—Generally includes "particleboard" (i.e., the first of the dry, reconstituted board products introduced) and medium-density fiberboard. (Hardboard is sometimes included as well; in this study, however, it is contained within paper and board.) These products are consumed in industrial uses, primarily furniture manufacturing.

Poletimber.—(See Stand-size class.)

Primary timber product.—Roundwood products, such as pulpwood, saw logs, veneer logs, and fuelwood. Mill residues are also included if they reenter the primary-mill processing stage.

Primary timber product production.—The annual quantity, determined from mill receipts of one or a group of roundwood products cut in a specific geographic area, plus the annual wood residue quantity produced by sawmills, veneer mills, etc., in a specific geographic area that was used for the product.

Primary timber product receipts.—The annual quantity of wood received by mills in a specific geographic area, regardless of the geographic source.

Primary wood-using mill.—Mills receiving roundwood or chips from roundwood.

Primary wood-using mill residue.—Wood materials and bark not utilized for principal products at primary mills using roundwood.

Removals.—The net volume of growing-stock or sawtimber trees removed from inventory by harvesting; cultural operations, such as timber stand improvement; land clearings; or changes in land use.

Roundwood.—Logs, bolts, or other round sections cut from trees.

Sawtimber.—(See Stand-size class.)

Secondary timber product.—Primary timber products which undergo further processing, such as paper and board, lumber, plywood and veneer, and particleboard.

Site class.—(See Forest site productivity class.)

Stand-age class.—Age of the main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Stand-size class.—A classification of forest land based on the size class of growing-stock trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

Sawtimber.—Growing-stock trees of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, International 1/4-inch rule, from stump to a minimum 7 inches top diameter outside bark (d.o.b.) for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Poletimber.—Growing-stock trees of commercial species at least 5 inches in diameter at breast height, but smaller than sawtimber size.

Saplings.—Live trees 1 to 5 inches in diameter at breast height.

Structural panel.—Includes softwood plywood as well as reconstituted board products which compete with plywood, such as waferboard, OSB, and composite plywood.

Use-factor approach.—Method of estimating product consumption (e.g., secondary wood product consumption) in major end-use markets which employs use-factors and demand indicators.

Demand indicator.—An indicator of the level of activity in an end-use market.

End-use market.—Major markets or activities in which products (e.g., secondary wood products) are used or consumed.

Use-factor.—A measure of product consumed (e.g., wood consumed) per unit of activity in an end-use market.

APPENDIX

HOW TO USE THE APPENDIX

Figures and tables in the appendix are organized in groups that correspond to the major timber resource and product sections in the text. These groups are shown below in conjunction with appropriate text section titles:

Figures	Tables	Title
2 - 8	5 - 13	Regional timber resources
9 - 28	14 - 29	Paper and board
29 - 35	30 - 47	Lumber
36 - 47	48 - 65	Plywood and veneer
48 - 50	66 - 71	Particleboard
	72	Fuelwood

Within the timber product sections, specific product categories are broken out (e.g., lumber used in pallet production, plywood used in residential alterations and repairs). Data for the individual States are given, usually along with Lake States totals. In order to find how much lumber was used, say, in furniture manufacturing in Minnesota, one would look to the group of Lumber tables (i.e., tables 30 - 47), locate the product category for lumber used in furniture manufacturing (i.e., table 39), and read the data for Minnesota.

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Table 71.—Particleboard used in furniture manufacturing in the Lake States, Michigan, Wisconsin, and Minnesota
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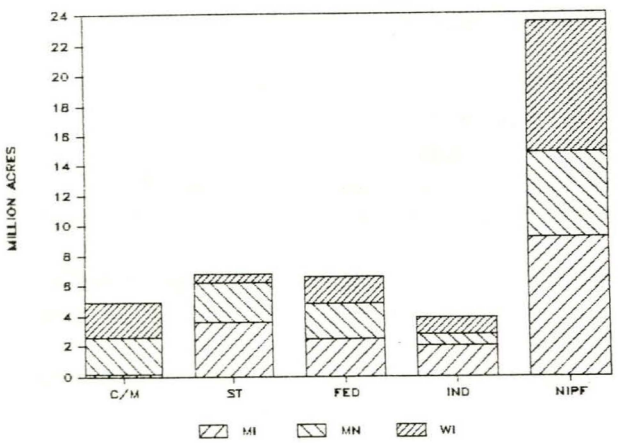

Figure 2.—*Commercial forest land ownership in the Lake States.*

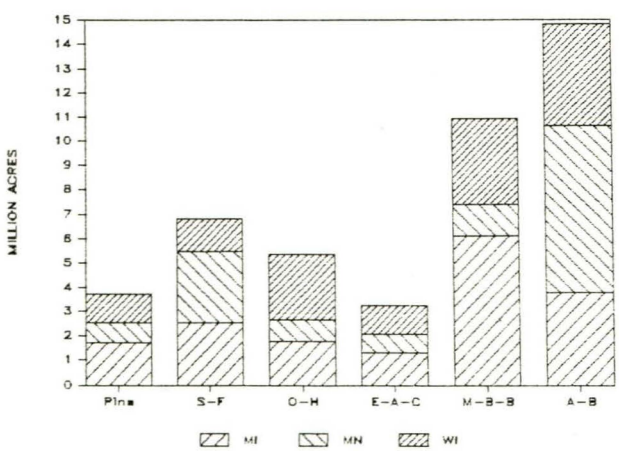

Figure 3.—*Forest types in the Lake States.*

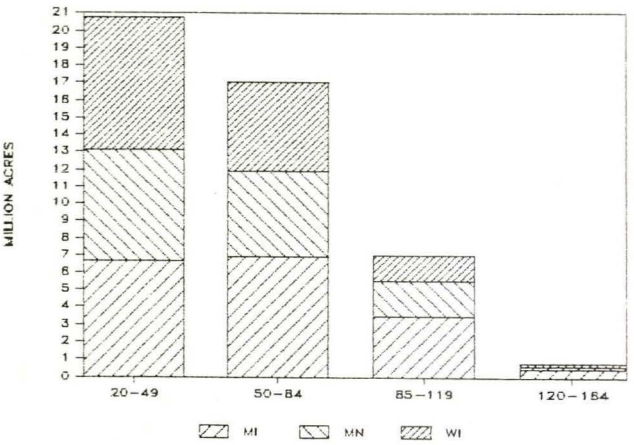

Figure 4.—*Site classes in the Lake States.*

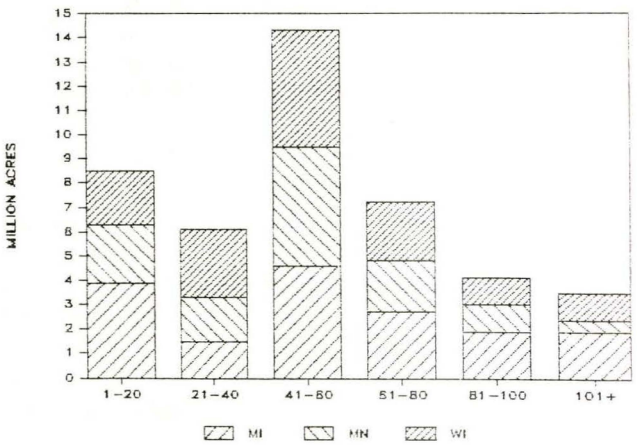

Figure 5.—*Stand-age classes in the Lake States.*

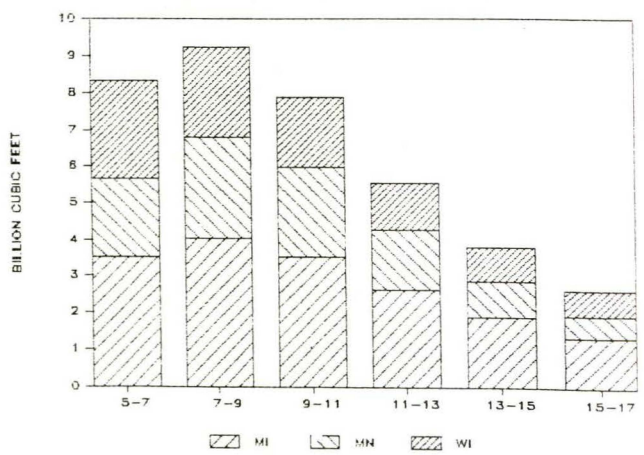

Figure 6.—*Lake States growing stock by diameter class.*

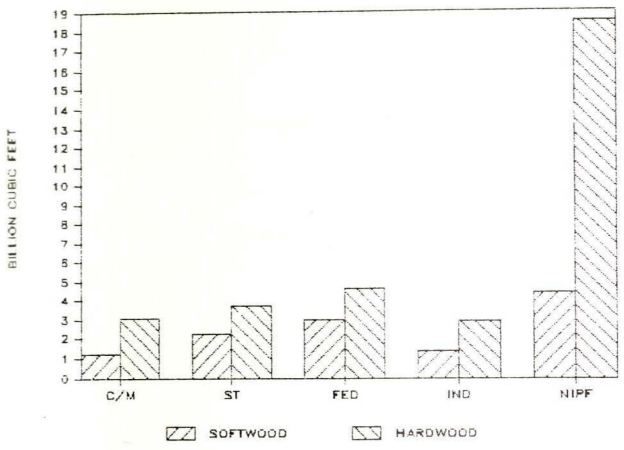

Figure 7.—*Lake States growing stock by ownership and species group.*

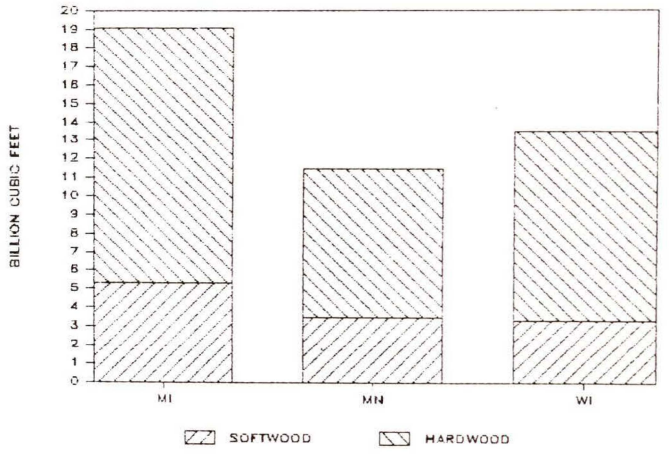

Figure 8.—*Lake States growing stock by species group and state.*

Table 5.--Forest land area in the Lake States by land class

(In million acres)

Forest land class	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
Commercial	17.5	13.7	14.5	45.7
Noncommercial				
Unproductive	.3	1.8	.4	2.5
Productive-reserved	.6	1.2	.0	1.8
Total	18.4	16.7	14.9	50.0

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ USDA Forest Service (1982).

Table 6.--Commercial forest land ownership in the Lake States

(In million acres)

Ownership	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
County/municipal	0.2	2.3	2.4	4.9
State	3.6	2.7	.6	6.8
Federal	2.5	2.3	1.8	6.6
Industry	2.0	0.8	1.2	3.9
Farm/nonindustrial private	9.2	5.6	8.6	23.5
Total	17.5	13.7	14.5	45.6

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ USDA Forest Service (1982).

Table 7.--Lake States forest types on commercial forest land

(In million acres)

Forest type	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
Pine	1.7	0.8	1.2	3.7
Spruce-fir	2.5	2.9	1.3	6.8
Oak-hickory	1.8	.9	2.7	5.3
Elm-ash-cottonwood	1.3	.7	1.2	3.2
Maple-beech-birch	6.1	1.3	3.6	10.9
Aspen-birch	3.8	6.9	4.2	14.8
Nonstocked	.3	.2	.3	.8
Total	17.5	13.7	14.5	45.6

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ Raile and Smith (1982).

Table 8.--Lake States commercial forest land area by stand-age class

(In million acres)

Age class	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
1 - 10	2.0	1.2	1.2	4.4
11 - 20	1.9	1.2	1.0	4.1
21 - 30	1.0	1.0	1.3	3.3
31 - 40	1.5	1.8	1.5	4.8
41 - 50	2.3	2.6	2.6	7.5
51 - 60	2.3	2.3	2.2	6.9
61 - 70	1.5	1.3	1.5	4.2
71 - 80	1.2	.8	.9	2.8
81 - 90	1.1	.6	.6	2.2
91 - 100	.8	.5	.5	1.8
101 - 120	1.2	.3	.8	2.3
121 - 140	.5	.2	.3	1.0
141 +	.2	.0[4/]	.0	.2

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ Raile and Smith (1982).
4/ Less than 50 thousand cubic feet.

Table 9.--Lake States commercial forest land area by site class

(In million acres)

Site class	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
20 - 49	6.7	6.5	7.7	20.8
50 - 84	6.9	5.0	5.2	17.1
85 - 119	3.5	2.0	1.5	7.0
120 - 164	.5	.2	.2	.8

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ Spencer and Thorne (1972).

Table 10.--Net volume of growing-stock in the Lake States by ownership and species group

(In billion cubic feet)

Ownership	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
County/municipal				
Softwood	0.1	0.6	0.6	1.2
Hardwood	.1	1.5	1.5	3.1
State				
Softwood	1.3	.8	.2	2.3
Hardwood	2.2	1.1	.3	3.7
Federal				
Softwood	1.1	1.1	.8	3.0
Hardwood	1.8	1.3	1.5	4.6
Industry				
Softwood	.8	.3	.4	1.4
Hardwood	1.7	.4	.9	2.9
Farm/nonindustrial private				
Softwood	2.1	.8	1.6	4.4
Hardwood	8.0	3.7	6.7	18.5

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ Spencer and Thorne (1972).

Table 11.--Net volume of growing-stock in the Lake States by forest type

(In billion cubic feet)

Forest type	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
Pine	1.6	1.0	1.2	3.8
Spruce-fir	2.6	1.8	1.2	5.5
Oak-hickory	2.0	.8	2.1	4.9
Elm-ash-cottonwood	1.3	.6	1.1	2.9
Maple-beech-birch	8.1	1.2	4.3	13.5
Aspen-birch	3.6	5.6	2.9	12.1
Nonstocked	.1	.0[4/]	.0	.1
Total	19.1	11.0	12.7	42.8

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ Spencer and Thorne (1972).
4/ Less than 50 thousand cubic feet.

Table 12.--Net volume of growing-stock in the Lake States by species group

(In billion cubic feet)

Species group	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
Softwoods	5.4	3.5	3.3	12.2
Hardwoods	13.8	8.0	10.1	31.9
Total	19.1	11.5	13.5	44.0

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ Spencer and Thorne (1972).

Table 13.--Net volume of growing-stock in the Lake States by diameter class

(In billion cubic feet)

Diameter Class	Michigan[1/]	Minnesota[2/]	Wisconsin[3/]	Lake States
5 - 6.9	3.5	2.2	2.7	8.4
7 - 8.9	4.0	2.8	2.5	9.2
9 - 10.9	3.5	2.4	1.9	7.9
11 - 12.9	2.6	1.7	1.3	5.6
13 - 14.9	1.9	1.0	.9	3.8
15 - 16.9	1.3	.6	.7	2.6
17 - 18.9	.9	.4	.5	1.7
19 - 20.9	.5	.2	.3	1.0
21 - 22.9	.3	.1	.2	.6
23 - 28.9	.4	.2	.3	.8
29 +	.1	.1	.1	.2

1/ Raile and Smith (1983).
2/ Jakes (1980b).
3/ Spencer and Thorne (1972).

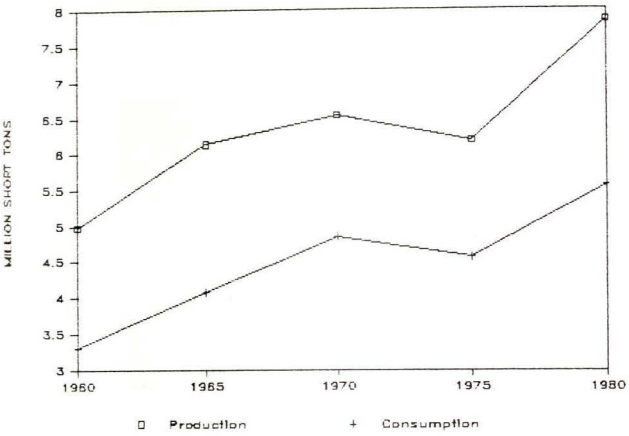

Figure 9.—*Lake States paper and board production and consumption.*

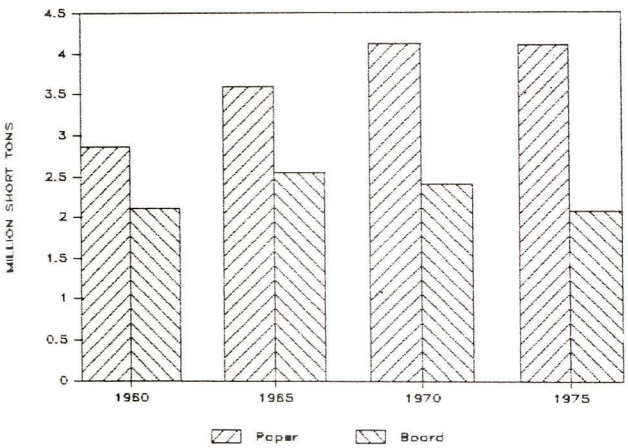

Figure 10.—*Paper production and board production in the Lake States.*

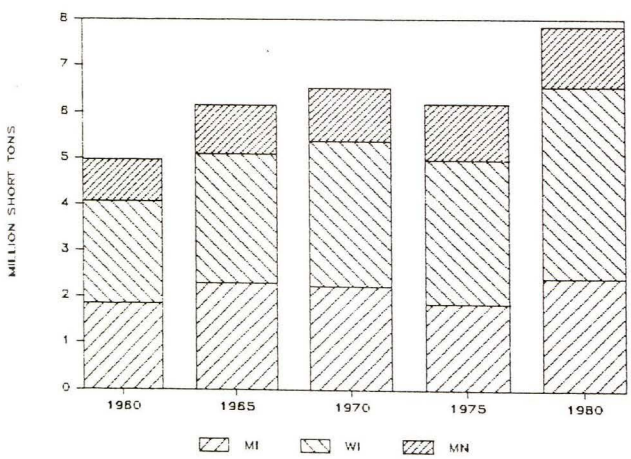

Figure 11.—*Paper and board production in the Lake States.*

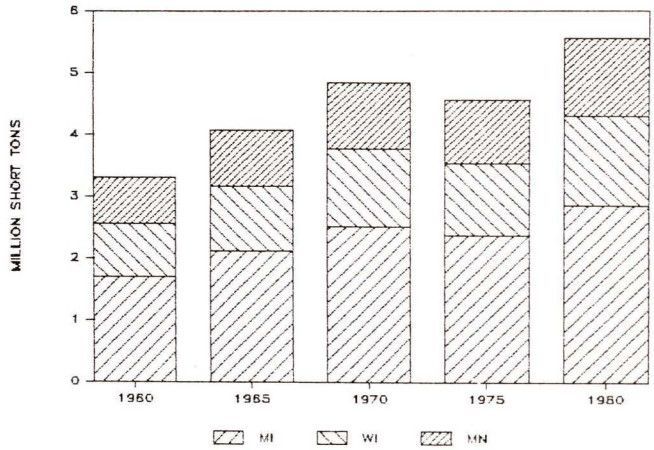

Figure 12.—*Paper and board consumption in the Lake States.*

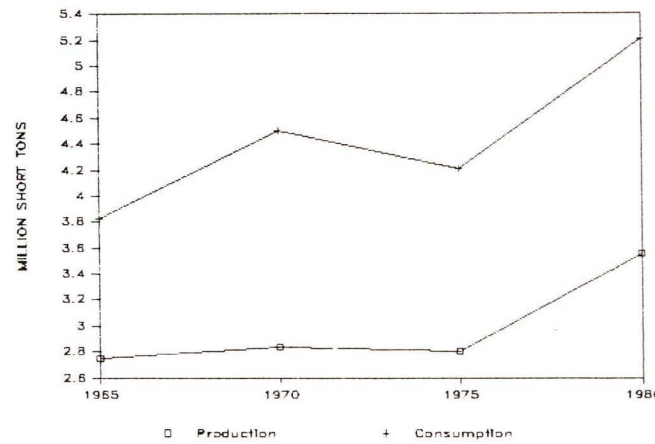

Figure 13.—*Lake States woodpulp production and consumption.*

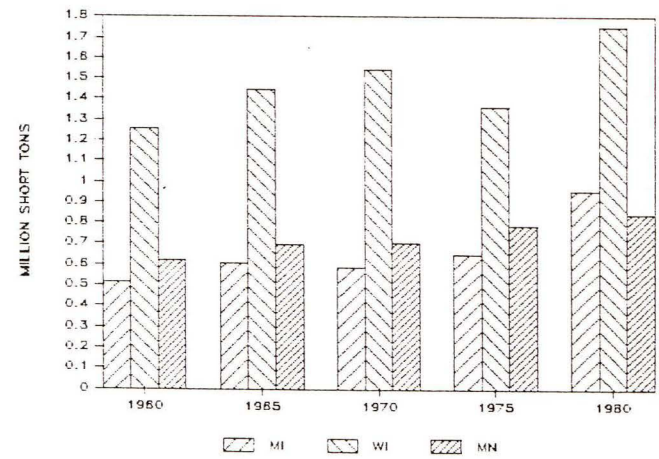

Figure 14.—*Woodpulp production in the Lake States.*

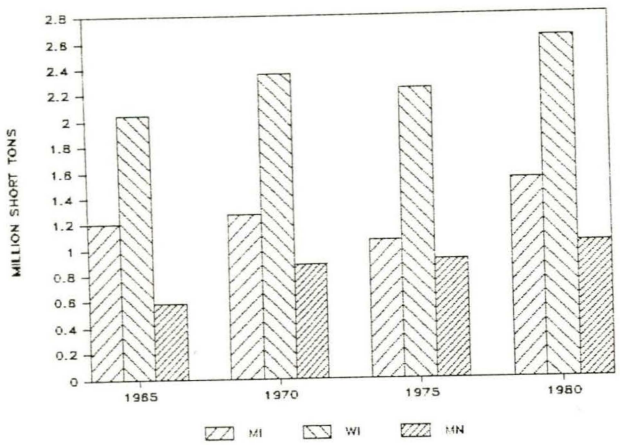

Figure 15.—*Woodpulp consumption in the Lake States.*

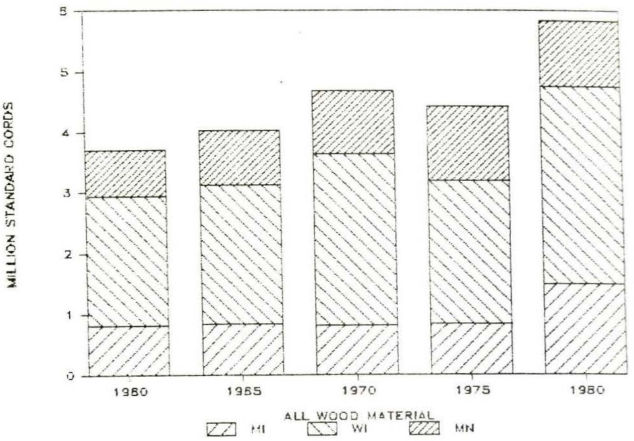

Figure 18.—*Pulpwood receipts in the Lake States.*

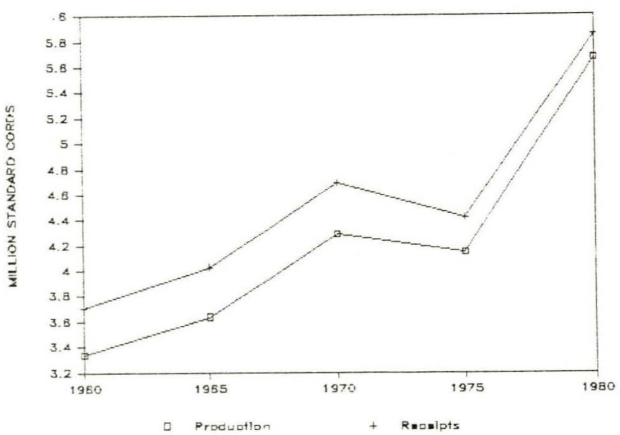

Figure 16.—*Pulpwood production and receipts in the Lake States.*

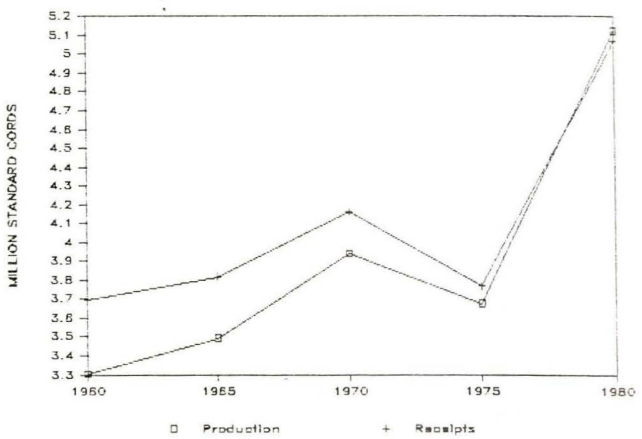

Figure 19.—*Roundwood pulpwood production and receipts in the Lake States.*

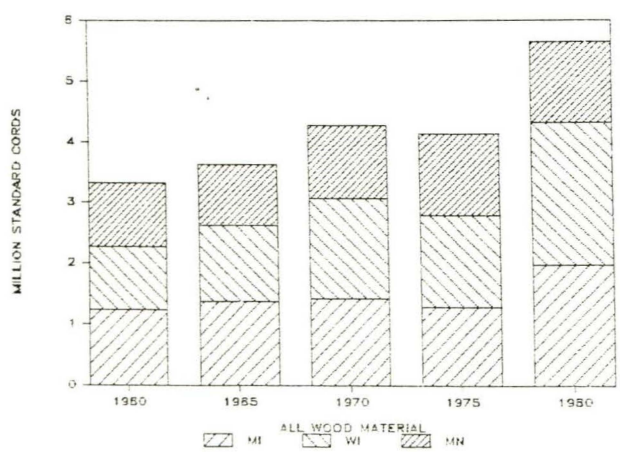

Figure 17.—*Pulpwood production in the Lake States.*

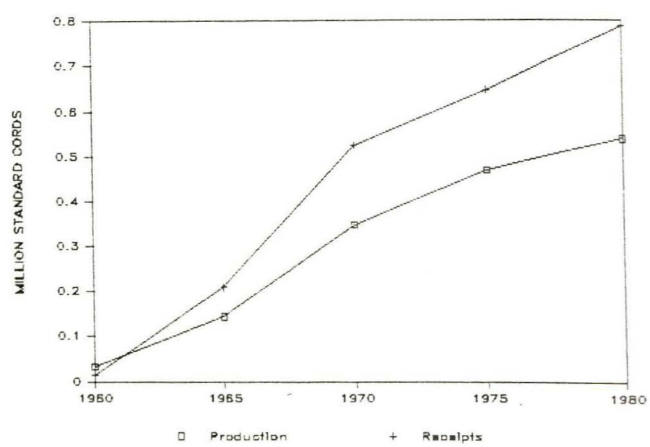

Figure 20.—*Production and receipts of pulpwood residues in the Lake States.*

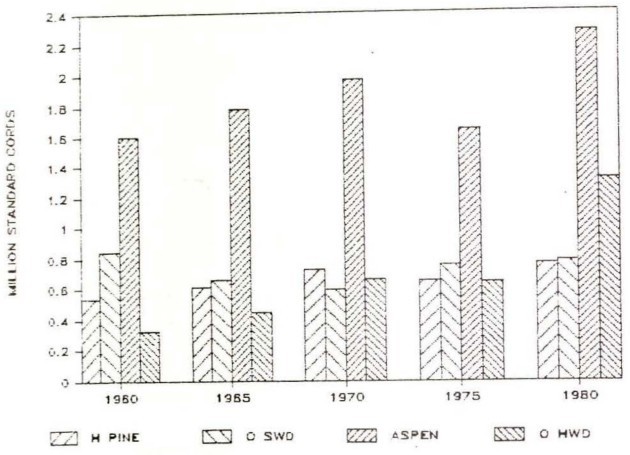

Figure 21.—*Roundwood pulpwood production in the Lake States by species groups.*

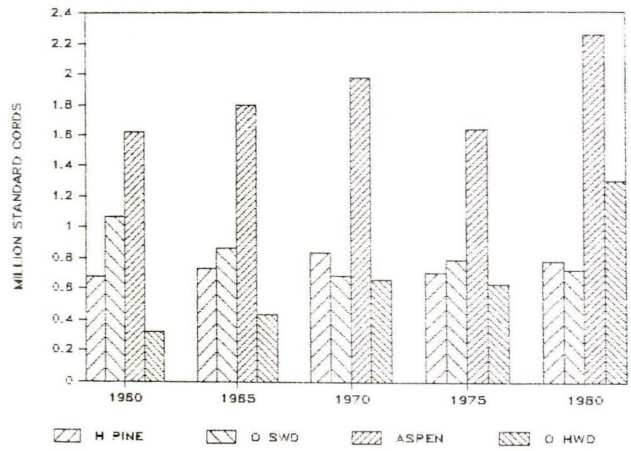

Figure 22.—*Roundwood pulpwood receipts in the Lake States by species groups.*

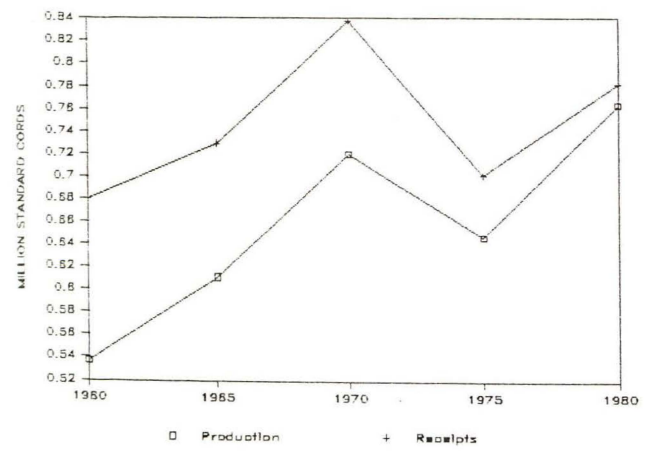

Figure 23.—*Production and receipts of hard pine roundwood pulpwood in the Lake States.*

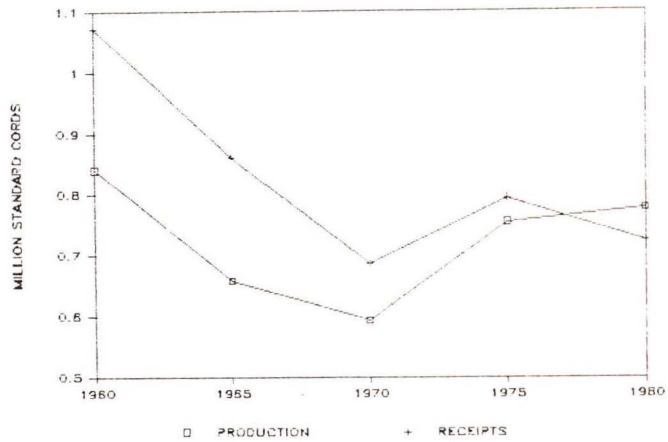

Figure 24.—*Production and receipts of other softwood roundwood pulpwood in the Lake States.*

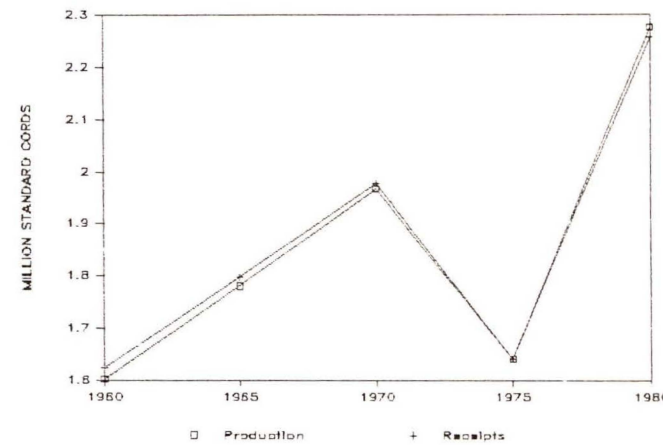

Figure 25.—*Production and receipts of aspen roundwood pulpwood in the Lake States.*

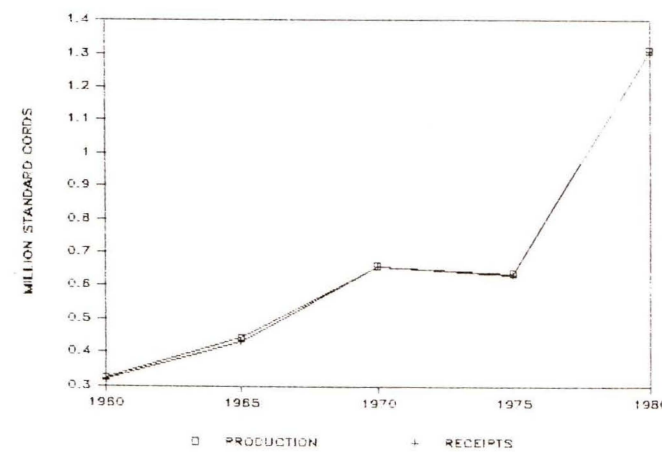

Figure 26.—*Production and receipts of other hardwood roundwood pulpwood in the Lake States.*

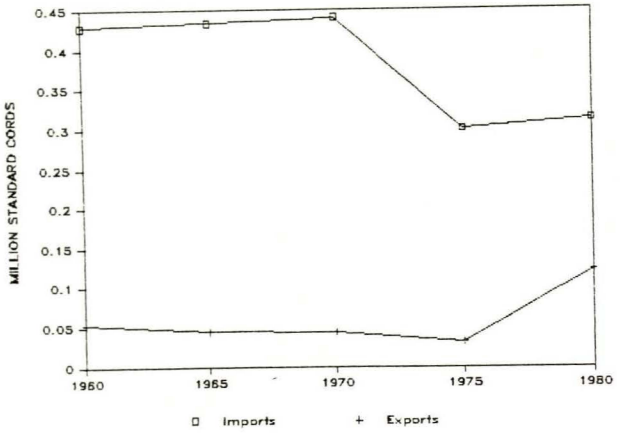

Figure 27.—*Lake States pulpwood imports and exports.*

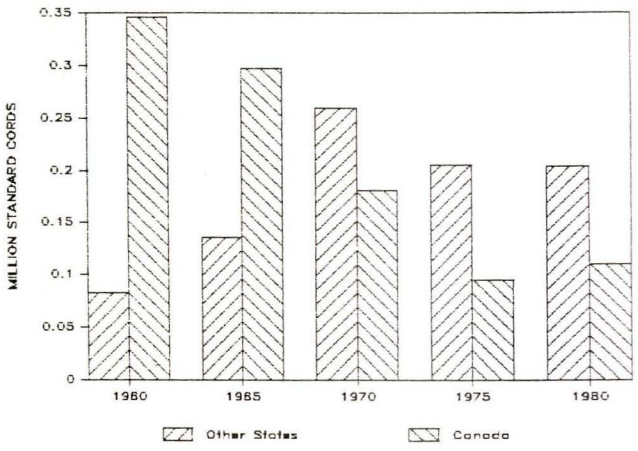

Figure 28.—*Pulpwood imports to the Lake States from other states and Canada.*

Table 14.--Paper and board production and consumption in the Lake States

(In thousand short tons)

Year	Production[1/]	Consumption[2/]
1982		
1981		
1980	7,846	5,564
1979	8,580	5,779
1978	7,793	5,664
1977	7,337	5,432
1976	NA	5,183
1975	6,182	4,559
1974	7,344	
1973	7,563	
1972	7,155	
1971	6,705	
1970	6,527	4,849
1969	6,762	
1968	6,404	
1967	6,118	
1966	6,397	
1965	6,134	
1964	5,770	
1963	5,369	
1962	5,184	
1961	4,931	
1960	4,978	3,296

[1/] U.S. Department of Commerce, Bureau of the Census, Current Industrial Report Series M26A.

[2/] Based on per capita paper and board consumption (Ulrich 1983).

Table 15.--Woodpulp production and consumption in the Lake States[1/]

(In thousand short tons)

Year	Production	Consumption
1982	3,189[2/]	4,482
1981	3,426	4,911
1980	3,555	5,209
1979	3,593	5,539
1978	3,355	4,983
1977	3,265	4,820
1976	3,201	4,732
1975	2,802	4,207
1974	3,287	5,081[2/]
1973	3,005	5,046[2/]
1972	2,972	4,827[2/]
1971	2,921	4,550[2/]
1970	2,838	4,503[2/]
1969	2,982	4,712[2/]
1968	2,641	4,042[2/]
1967	2,652	4,076[2/]
1966	2,762	3,894[2/]
1965	2,750	3,830[2/]
1964	2,766[2/]	3,762[2/]
1963	2,550	
1962	2,507	
1961	2,421	
1960	2,394	

[1/] U.S. Department of Commerce, Bureau of the Census, Current Industrial Report Series M26A.

[2/] Minnesota's production and consumption data was not disclosed for these years; therefore, West North Central data represents Minnesota.

Table 16.--Wastepaper utilization by paper and board mills in the Lake States[1/]

(In thousand short tons)

Year	Paper & board produced	Utilization rate[2/]	Wastepaper used
1981	NA	23.9	NA
1980	7,846	23.4	1,836
1979	8,580	23.8	2,042
1978	7,793	23.7	1,847
1977	7,337	23.3	1,710
1976	NA	23.3	NA
1975	6,182	22.9	1,416
1974	7,344	23.6	1,733
1973	7,563	23.5	1,777
1972	7,155	22.5	1,610
1971	6,705	22.8	1,529
1970	6,527	22.8	1,488

[1/] American Paper Institute, statistics of paper, paperboard and woodpulp.

[2/] The utilization rate equals the ratio of recyclable paper consumption to total production of paper and board.

Table 17.--Paper and board production and consumption in Michigan, Wisconsin, and Minnesota

(In thousand short tons)

Year	Production[1]			Consumption		
	Paper	Board: all grades[2]	Total	Per capita[3]	Residential population	Total
				Pounds	Thousand	
MICHIGAN						
1982	913	[4]	[4]		9,109	
1981	1,177	[4]	[4]		9,215	
1980	1,115	1,289	2,404	616	9,255	2,851
1979	1,290	1,248	2,538	644	9,249	2,978
1978	1,261	1,281	2,542	635	9,202	2,922
1977	1,141	1,300	2,441	612	9,157	2,802
1976	NA	NA	NA	587	9,117	2,676
1975	829	1,026	1,855	518	9,108	2,359
1974	1,133	1,341	2,474	605		
1973	1,134	1,456	2,590	631		
1972	998	1,416	2,414	615		
1971	892	1,383	2,275	575		
1970	955	1,280	2,235	566	8,895	2,517
1969	949	1,356	2,305	582		
1968	910	1,319	2,229	556		
1967	822	1,391	2,213	524		
1966	925	1,455	2,380	537		
1965	885	1,403	2,288	507		
1964	818	1,340	2,158	485		
1963	802	1,197	1,999	464		
1962	789	1,147	1,936	454		
1961	748	1,080	1,828	440		
1960	731	1,112	1,843	434	7,823	1,698
WISCONSIN						
1982	3,459	[4]	[4]		4,765	
1981	3,582	537	4,119		4,740	
1980	3,491	668	4,159	616	4,728	1,456
1979	3,594	768	4,362	644	4,660	1,501
1978	3,151	656	3,807	635	4,631	1,470
1977	2,899	533	3,432	612	4,613	1,412
1976	NA	NA	NA	587	4,585	1,346
1975	2,657	445	3,102	518	4,570	1,184
1974	3,015	559	3,574	605		
1973	3,045	622	3,667	631		
1972	2,817	640	3,457	615		
1971	2,621	612	3,233	575		
1970	2,550	580	3,130	566	4,426	1,253
1969	2,717	575	3,292	582		
1968	2,438	589	3,027	556		
1967	2,302	531	2,833	524		
1966	2,339	581	2,920	537		
1965	2,221	566	2,787	507		
1964	2,080	544	2,624	485		
1963	1,942	519	2,461	464		
1962	1,840	515	2,355	454		
1961	1,766	487	2,253	440		
1960	1,763	462	2,225	434	3,952	858

(Table 17 continued on next page)

(Table 17 continued)

MINNESOTA

Year	Production[1]			Consumption		
	Paper	Board: all grades[2]	Total	Per capita[3]	Residential population	Total
				Pounds	Thousand	
1982	856	[4]	[4]		4,133	
1981	816	[4]	[4]		4,113	
1980	[4]	[4]	1,283	616	4,083	1,258
1979	[4]	[4]	1,680	644	4,038	1,300
1978	[4]	[4]	1,444	635	4,005	1,272
1977	808	656	1,464	612	3,980	1,218
1976	NA	NA	NA	587	3,957	1,161
1975	620	605	1,225	518	3,926	1,017
1974	664	632	1,296	605		
1973	652	654	1,306	631		
1972	657	627	1,284	615		
1971	606	591	1,197	575		
1970	609	553	1,162	566	3,814	1,079
1969	608	557	1,165	582		
1968	574	574	1,148	556		
1967	546	526	1,072	524		
1966	530	567	1,097	537		
1965	484	575	1,059	507		
1964	453	535	988	485		
1963	415	494	909	464		
1962	405	488	893	454		
1961	367	483	850	440		
1960	374	536	910	434	3,414	741

[1] U.S. Department of Commerce, Bureau of the Census, Current Industrial Report Series M26A.

[2] Board: all grades equals the total production of paperboard, wet machine board, and construction paper and board.

[3] Ulrich (1983).

[4] Non-disclosure.

Table 18.--Woodpulp production and consumption in Michigan, Wisconsin, and Minnesota[1/]

(In thousand short tons)

Year	Production	Consumption		
	total	Own	Purchase	Total
MICHIGAN				
1982	849	615	463	1,078
1981	967	738	488	1,226
1980	958	885	645	1,530
1979	955	905	734	1,639
1978	923	882	545	1,427
1977	862	834	466	1,300
1976	805	774	466	1,240
1975	649	672	387	1,059
1974	873	902	531	1,433
1973	594	865	534	1,399
1972	615	807	517	1,324
1971	573	789	415	1,204
1970	587	839	425	1,264
1969	589	850	475	1,325
1968	496	757	367	1,124
1967	576	835	340	1,175
1966	590	763	443	1,206
1965	606	806	398	1,204
1964	570	727	407	1,134
1963	549			
1962	500			
1961	477			
1960	515			
WISCONSIN				
1982	1,541	1,778	735	2,513
1981	1,688	1,910	817	2,727
1980	1,750	1,655	979	2,634
1979	1,711	1,825	975	2,800
1978	1,486	1,625	805	2,430
1977	1,471	1,637	774	2,411
1976	1,489	1,622	804	2,426
1975	1,363	1,530	705	2,235
1974	1,537	1,693	880	2,573
1973	1,619	1,818	886	2,704
1972	1,596	1,758	793	2,551
1971	1,610	1,779	652	2,431
1970	1,545	1,700	659	2,359
1969	1,657	1,816	646	2,462
1968	1,444	1,638	589	2,227
1967	1,424	1,550	559	2,109
1966	1,471	1,633	472	2,105
1965	1,448	1,606	435	2,041
1964	1,407	1,515	384	1,899
1963	1,400			
1962	1,340			
1961	1,290			
1960	1,257			

(Table 18 continued on next page)

(Table 18 continued)

MINNESOTA

Year	Production total	Consumption		
		Own	Purchase	Total
1982	799[2/]	[3/]	[3/]	891
1981	771	[3/]	[3/]	958
1980	847	819	226	1,045
1979	927	899	201	1,100
1978	946	941	185	1,126
1977	932	916	194	1,109
1976	907	899	167	1,066
1975	790	773	140	913
1974	877	908[2/]	167[2/]	1,075
1973	792	836[2/]	108[2/]	943
1972	761	859[2/]	93[2/]	952
1971	738	791[2/]	124[2/]	915
1970	706	755[2/]	124[2/]	880
1969	736	796[2/]	129[2/]	925
1968	701	576[2/]	115[2/]	691
1967	652	687[2/]	106[2/]	792
1966	701	479[2/]	104[2/]	583
1965	696	482[2/]	103[2/]	585
1964	789[2/]	636	93	729
1963	601			
1962	667			
1961	654			
1960	622			

[1/] U.S. Department of Commerce, Bureau of the Census, Current Industrial Report Series M26A.

[2/] Minnesota's figures were not disclosed in these categories; therefore, West North Central figures are shown, in which Minnesota represents a large share.

[3/] Non-disclosure.

Table 19.--Wastepaper utilization by paper and board mills in Michigan, Wisconsin, and Minnesota[1/]

(In thousand short tons)

Year	Paper & board produced	Utilization rate[2/]	Wastepaper used
	MICHIGAN		
1981	[3/]	23.9	NA
1980	2,404	23.4	563
1979	2,538	23.8	604
1978	2,542	23.7	602
1977	2,441	23.3	569
1976	NA	23.3	NA
1975	1,855	22.9	425
1974	2,474	23.6	584
1973	2,590	23.5	609
1972	2,414	22.5	543
1971	2,275	22.8	519
1970	2,235	22.8	510
	WISCONSIN		
1981	4,119	23.9	984
1980	4,159	23.4	973
1979	4,362	23.8	1,038
1978	3,807	23.7	902
1977	3,432	23.3	800
1976	NA	23.3	NA
1975	3,102	22.9	710
1974	3,574	23.6	843
1973	3,667	23.5	862
1972	3,457	22.5	778
1971	3,233	22.8	737
1970	3,130	22.8	714
	MINNESOTA		
1981	[3/]	23.9	NA
1980	1,283	23.4	300
1979	1,680	23.8	400
1978	1,444	23.7	342
1977	1,464	23.3	341
1976	NA	23.3	NA
1975	1,225	22.9	281
1974	1,296	23.6	306
1973	1,306	23.5	307
1972	1,284	22.5	289
1971	1,197	22.8	273
1970	1,162	22.8	265

[1/] American Paper Institute, Statistics of Paper, Paperboard and Woodpulp.

[2/] The utilization rate equals the ratio of recyclable paper consumption to total production of paper and board.

[3/] Non-disclosure.

Table 20.--Pulpwood production in the Lake States[1/]

(All wood, in thousand standard cords)

Year	Michigan	Wisconsin	Minnesota	Total
1982	1,750	2,286	1,484	5,520
1981	1,837	2,389	1,370	5,596
1980	1,969	2,362	1,333	5,664
1979	1,980	2,109	1,459	5,548
1978	1,675	1,895	1,338	4,908
1977	1,595	1,816	1,333	4,744
1976	1,541	1,840	1,308	4,689
1975	1,281	1,505	1,359	4,145
1974	1,842	2,053	1,578	5,473
1973	1,586	1,758	1,377	4,721
1972	1,396	1,537	1,354	4,287
1971	1,267	1,552	1,196	4,015
1970	1,406	1,656	1,224	4,286
1969	1,302	1,450	1,192	3,944
1968	1,168	1,297	1,087	3,552
1967	1,344	1,416	1,205	3,965
1966	1,570	1,536	1,174	4,280
1965	1,365	1,253	1,018	3,636
1964	1,321	1,244	1,062	3,627
1963	1,297	1,302	1,063	3,662
1962	1,223	1,141	978	3,342
1961	1,107	1,078	968	3,153
1960	1,237	1,052	1,048	3,337

[1/] USDA Forest Service, Pulpwood Production in the North-Central Region by County.

Table 21.--Pulpwood receipts in the Lake States[1/]

(All wood, in thousand standard cords)

Year	Michigan	Wisconsin	Minnesota	Total
1982	1,388	2,978	1,298	5,664
1981	1,448	3,154	1,164	5,766
1980	1,493	3,266	1,097	5,856
1979	1,491	3,067	1,295	5,853
1978	1,332	2,676	1,218	5,226
1977	1,231	2,596	1,209	5,036
1976	1,115	2,713	1,177	5,005
1975	843	2,344	1,226	4,413
1974	1,324	3,135	1,392	5,851
1973	1,198	2,696	1,222	5,116
1972	931	2,450	1,224	4,605
1971	699	2,581	1,064	4,344
1970	806	2,821	1,058	4,685
1969	772	2,513	1,082	4,367
1968	774	2,226	992	3,992
1967	773	2,729	958	4,460
1966	1,003	2,701	1,140	4,844
1965	825	2,290	912	4,027
1964	791	2,271	938	4,000
1963	742	2,429	921	4,092
1962	679	2,124	828	3,631
1961	700	1,972	784	3,456
1960	810	2,115	787	3,712

[1/] USDA Forest Service, Pulpwood Production in the North-Central Region by County.

Table 22.--Lake States pulpwood imports and exports[1/]

(All wood, in thousand standard cords)

Year	Imports			Exports
	Other States	Canada	Total	Outside region
1982	147	53	200	56
1981	180	90	270	101
1980	203	110	313	121
1979	309	113	422	118
1978	272	109	381	64
1977	255	110	365	71
1976	236	132	368	53
1975	205	95	300	31
1974	294	132	426	48
1973	332	150	482	84
1972	244	118	362	48
1971	246	126	372	43
1970	260	181	441	43
1969	268	207	475	52
1968	231	254	485	44
1967	239	292	531	36
1966	264	332	596	32
1965	136	298	434	44
1964	135	271	406	32
1963	153	309	462	32
1962	108	206	314	26
1961	44	303	347	43
1960	82	347	429	54

[1/] USDA Forest Service, Pulpwood Production in the North-Central Region by County.

Table 23.--Lake States pulpwood production for flakeboard plants[1/]

(In thousand cords)

	1981	1982
Roundwood		
Aspen	382	554
Other species	54	48
Residue	60	73
Total	496	675

[1/] Blyth and Smith (1984a). Flakeboard production equals particleboard production, as defined in this study.

Table 24.--Pulpwood production in Michigan, Wisconsin, and Minnesota by state of destination[1/]

(All wood, in thousand standard cords)

Year	Destination				Total
	Michigan	Wisconsin	Minnesota	Outside region	
MICHIGAN					
1982	1,341	396	0[2/]	15	1,752
1981	1,402	419	0	17	1,838
1980	1,442	490	0	36	1,968
1979	1,428	516	0	37	1,981
1978	1,248	404	0	23	1,675
1977	1,158	407	0	29	1,594
1976	1,081	434	0	26	1,541
1975	814	449	0	17	1,280
1974	1,290	534	0	19	1,843
1973	1,131	418	0	36	1,585
1972	917	470	0	14	1,401
1971	688	567	0	12	1,267
1970	785	610	0	11	1,406
1969	752	537	0	13	1,302
1968	702	455	0	11	1,168
1967	684	660	0	0	1,344
1966	901	666	1	2	1,570
1965	750	608	0	7	1,365
1964	730	588	0	3	1,321
1963	664	628	0	0	1,292
1962	677	540	0	7	1,224
1961	628	464	0	14	1,106
1960	727	510	0	0	1,237
WISCONSIN					
1982	28	2,231	26	0	2,286
1981	26	2,320	34	9	2,389
1980	35	2,298	18	12	2,362
1979	47	2,024	21	18	2,109
1978	70	1,779	26	20	1,895
1977	64	1,714	26	12	1,816
1976	24	1,784	23	9	1,840
1975	19	1,460	20	6	1,505
1974	25	2,004	14	10	2,053
1973	55	1,671	14	18	1,758
1972	2	1,493	28	14	1,437
1971	0	1,502	35	15	1,552
1970	10	1,627	11	8	1,656
1969	9	1,412	17	12	1,450
1968	4	1,259	22	12	1,297
1967	0	1,337	15	14	1,416
1966	3	1,501	13	19	1,536
1965	1	1,225	8	19	1,253
1964	2	1,207	19	16	1,244
1963	2	1,262	20	18	1,302
1962	1	1,114	15	10	1,140
1961	1	1,050	14	14	1,078
1960	0	1,008	19	25	1,052

(Table 24 continued on next page)

(Table 24 continued)

Year	MINNESOTA Destination				Total
	Michigan	Wisconsin	Minnesota	Outside region	
1982	0	179	1,264	41	1,484
1981	0	177	1,119	75	1,371
1980	0	216	1,044	73	1,333
1979	0	169	1,226	63	1,458
1978	0	162	1,155	21	1,338
1977	0	154	1,149	30	1,333
1976	0	182	1,109	18	1,309
1975	0	178	1,173	8	1,359
1974	0	262	1,297	19	1,578
1973	0	194	1,152	30	1,376
1972	0	166	1,168	20	1,354
1971	0	188	992	16	1,196
1970	0	219	981	24	1,224
1969	0	188	977	27	1,192
1968	0	166	900	21	1,087
1967	0	299	884	22	1,205
1966	0	193	970	11	1,174
1965	0	159	842	18	1,019
1964	0	193	856	13	1,062
1963	0	221	828	14	1,063
1962	1	216	753	9	979
1961	0	240	712	15	967
1960	0	308	711	29	1,048

1/ USDA Forest Service, Pulpwood Production in the North-Central Region by County.

2/ Less than 500 standard cords.

Table 25.--Pulpwood production in the Lake States, Michigan, Wisconsin, and Minnesota by species group[1/]

(In thousand standard cords)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
				LAKE STATES			
1982	881	759	2,382	1,042	5,063	457	5,520
1981	751	680	2,418	1,190	5,039	557	5,596
1980	763	776	2,277	1,309	5,125	539	5,664
1979	836	664	2,298	1,195	4,992	555	5,548
1978	786	661	1,959	1,021	4,427	481	4,908
1977	702	679	1,925	936	4,242	602	4,744
1976	710	661	1,857	1,006	4,234	455	4,689
1975	646	754	1,640	638	3,677	468	4,145
1974	760	696	2,307	1,196	4,959	514	5,473
1973	640	607	2,037	976	4,260	461	4,721
1972	690	546	1,902	797	3,935	352	4,287
1971	717	493	1,891	605	3,706	309	4,015
1970	720	592	1,967	659	3,938	348	4,286
1969	660	479	1,963	555	3,657	287	3,944
1968	607	484	1,753	449	3,293	259	3,552
1967	569	666	1,976	539	3,750	215	3,965
1966	721	666	2,198	520	4,105	175	4,280
1965	611	657	1,780	444	3,492	144	3,636
1964	570	707	1,729	493	3,499	128	3,627
1963	552	782	1,708	488	3,530	132	3,662
1962	573	696	1,579	430	3,278	64	3,342
1961	515	757	1,457	382	3,111	42	3,153
1960	537	841	1,601	324	3,303	33	3,337
				MICHIGAN			
1982	243	269	632	485	1,629	121	1,750
1981	217	224	652	578	1,671	166	1,837
1980	250	256	705	605	1,816	153	1,969
1979	341	188	709	564	1,802	178	1,980
1978	266	197	586	479	1,528	147	1,675
1977	249	227	532	395	1,403	192	1,595
1976	267	206	491	389	1,353	188	1,541
1975	228	181	436	254	1,099	182	1,281
1974	250	182	706	508	1,646	196	1,842
1973	203	178	603	426	1,410	176	1,586
1972	228	151	529	345	1,253	143	1,396
1971	235	142	547	220	1,144	123	1,267
1970	240	189	596	229	1,254	152	1,406
1969	207	148	606	219	1,180	122	1,302
1968	205	148	541	184	1,078	90	1,168
1967	193	227	646	210	1,276	68	1,344
1966	250	262	776	207	1,495	75	1,570
1965	224	205	704	181	1,314	51	1,365
1964	198	217	675	184	1,274	47	1,321
1963	174	274	662	154	1,264	33	1,297
1962	184	251	601	165	1,201	22	1,223
1961	156	260	558	112	1,086	21	1,107
1960	188	295	669	83	1,235	2	1,237

(Table 25 continued on next page)

(Table 25 continued)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
				WISCONSIN			
1982	473	193	884	494	2,043	243	2,286
1981	398	187	965	548	2,098	291	2,389
1980	369	190	873	641	2,073	289	2,362
1979	341	165	751	593	1,849	259	2,109
1978	339	169	669	494	1,671	224	1,895
1977	283	154	696	486	1,619	297	1,816
1976	274	166	693	539	1,672	168	1,840
1975	227	186	588	327	1,327	178	1,505
1974	278	164	797	608	1,847	206	2,053
1973	232	116	761	472	1,581	177	1,758
1972	246	106	684	380	1,416	121	1,537
1971	268	111	736	320	1,435	117	1,552
1970	259	141	771	372	1,543	113	1,656
1969	216	116	697	301	1,330	120	1,450
1968	199	111	629	241	1,180	117	1,297
1967	174	105	739	287	1,305	111	1,416
1966	215	145	810	281	1,451	85	1,536
1965	206	129	608	222	1,165	88	1,253
1964	168	132	603	265	1,168	76	1,244
1963	170	138	613	283	1,204	98	1,302
1962	188	110	572	229	1,099	42	1,141
1961	154	138	530	235	1,057	21	1,078
1960	124	126	540	230	1,020	31	1,052
				MINNESOTA			
1982	165	297	866	63	1,391	93	1,484
1981	136	269	801	64	1,270	100	1,370
1980	144	330	699	63	1,236	97	1,333
1979	154	311	838	38	1,341	118	1,459
1978	181	295	704	48	1,228	110	1,338
1977	170	298	697	55	1,220	113	1,333
1976	169	289	673	78	1,209	99	1,308
1975	191	387	616	57	1,251	108	1,359
1974	232	350	804	80	1,466	112	1,578
1973	205	313	673	78	1,269	108	1,377
1972	216	289	689	72	1,266	88	1,354
1971	214	240	608	65	1,127	69	1,196
1970	221	262	600	58	1,141	83	1,224
1969	237	215	660	35	1,147	45	1,192
1968	203	225	583	24	1,035	52	1,087
1967	202	334	591	42	1,169	36	1,205
1966	256	259	612	32	1,159	15	1,174
1965	181	323	468	41	1,013	5	1,018
1964	204	358	451	44	1,057	5	1,062
1963	208	370	433	51	1,062	1	1,063
1962	201	335	406	36	978	0[2/]	978
1961	205	359	369	35	968	0	968
1960	225	420	392	11	1,048	0	1,048

[1/] USDA Forest Service, Pulpwood Production in the North-Central Region by County.

[2/] Less than 500 standard cords.

Table 26.--Pulpwood receipts in Michigan, Wisconsin, and Minnesota by state of origin[1/]

(All wood, in thousand standard cords)

Year	Origin					
	Michigan	Wisconsin	Minnesota	Other States	Canada	Total
MICHIGAN						
1982	1,341	28	0[2/]	16	3	1,388
1981	1,402	26	0	16	4	1,448
1980	1,442	35	0	13	3	1,493
1979	1,428	47	0	14	2	1,491
1978	1,248	70	0	10	4	1,332
1977	1,158	64	0	9	0	1,231
1976	1,081	24	0	7	3	1,115
1975	814	19	0	10	0	843
1974	1,290	25	0	9	0	1,324
1973	1,131	55	0	12	0	1,198
1972	917	2	0	12	0	931
1971	688	0	0	11	0	699
1970	785	10	0	10	1	806
1969	752	9	0	9	2	772
1968	702	4	0	7	61	774
1967	684	0	0	4	85	773
1966	901	3	0	2	97	1,003
1965	750	1	0	0	74	825
1964	730	2	0	0	59	791
1963	669	2	0	0	71	742
1962	677	1	1	0	0	679
1961	628	1	0	0	71	700
1960	727	0	0	0	83	810
WISCONSIN						
1982	396	2,231	179	131	42	2,978
1981	419	2,320	177	164	75	3,154
1980	490	2,298	216	170	92	3,266
1979	516	2,024	169	266	92	3,067
1978	404	1,779	162	242	88	2,676
1977	407	1,714	154	227	95	2,596
1976	434	1,784	182	203	110	2,713
1975	449	1,460	178	177	80	2,344
1974	534	2,004	262	269	67	3,135
1973	415	1,671	194	291	123	2,696
1972	470	1,493	166	230	92	2,450
1971	567	1,502	188	234	90	2,581
1970	610	1,627	219	249	115	2,821
1969	537	1,412	188	257	119	2,513
1968	455	1,259	166	223	124	2,226
1967	660	1,387	299	234	149	2,729
1966	666	1,501	193	185	156	2,701
1965	608	1,225	159	135	163	2,290
1964	588	1,207	193	135	149	2,271
1963	628	1,262	221	153	165	2,429
1962	540	1,114	216	108	146	2,124
1961	464	1,050	240	44	174	1,972
1960	510	1,008	308	82	207	2,115

(Table 26 continued on next page)

(Table 26 continued)

Year	MINNESOTA Origin					
	Michigan	Wisconsin	Minnesota	Other States	Canada	Total
1982	0	26	1,264	0	8	1,298
1981	0	34	1,119	0	11	1,164
1980	0	18	1,044	20	15	1,097
1979	0	21	1,226	29	19	1,295
1978	0	26	1,155	20	17	1,218
1977	0	26	1,149	19	15	1,209
1976	0	23	1,109	26	19	1,177
1975	0	20	1,173	18	15	1,226
1974	0	14	1,297	16	65	1,392
1973	0	14	1,152	29	27	1,222
1972	0	28	1,168	2	26	1,224
1971	0	35	992	1	36	1,064
1970	0	11	981	1	65	1,058
1969	0	17	977	2	86	1,082
1968	0	22	900	1	69	992
1967	0	15	884	1	58	958
1966	1	13	970	77	79	1,140
1965	0	8	842	1	61	912
1964	0	19	856	0	63	938
1963	0	20	828	0	73	921
1962	0	15	753	0	60	828
1961	0	14	712	0	58	784
1960	0	19	711	0	57	787

1/ USDA Forest Service, Pulpwood Production in the North-Central Region by County.

2/ Less than 500 standard cords.

Table 27.--Pulpwood receipts in the Lake States, Michigan, Wisconsin, and Minnesota by species group[1/]

(In thousand standard cords)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
				LAKE STATES			
1982	882	735	2,370	1,042	5,029	637	5,666
1981	763	650	2,393	1,186	4,992	775	5,767
1980	782	722	2,257	1,306	5,067	789	5,856
1979	886	659	2,258	1,186	4,989	863	5,852
1978	827	658	1,958	1,010	4,453	772	5,225
1977	738	691	1,909	931	4,269	771	5,040
1976	756	697	1,852	1,002	4,307	698	5,005
1975	701	794	1,639	634	3,768	647	4,415
1974	826	745	2,308	1,198	5,077	774	5,851
1973	676	710	2,027	959	4,372	744	5,116
1972	736	631	1,910	796	4,073	533	4,606
1971	783	570	1,894	607	3,854	491	4,345
1970	838	685	1,977	659	4,159	525	4,684
1969	803	581	1,969	557	3,910	457	4,367
1968	744	645	1,764	449	3,602	392	3,994
1967	712	884	1,990	543	4,129	332	4,461
1966	823	955	2,225	513	4,516	251	4,767
1965	729	861	1,797	431	3,818	209	4,027
1964	670	911	1,739	484	3,804	198	4,002
1963	688	1,014	1,722	481	3,905	188	4,093
1962	681	840	1,589	422	3,532	100	3,632
1961	626	967	1,467	372	3,432	24	3,456
1960	680	1,073	1,624	320	3,697	15	3,712
				MICHIGAN			
1982	198	202	493	379	1,272	116	1,388
1981	170	160	486	467	1,283	165	1,448
1980	188	156	525	467	1,336	157	1,493
1979	217	122	526	428	1,293	197	1,490
1978	208	143	423	382	1,156	176	1,332
1977	197	160	370	316	1,043	190	1,233
1976	202	104	327	310	943	171	1,114
1975	162	57	288	204	711	133	844
1974	151	85	481	447	1,164	160	1,324
1973	134	91	404	414	1,043	154	1,197
1972	127	70	322	317	835	96	932
1971	115	39	298	187	639	62	701
1970	152	51	332	182	717	88	805
1969	116	38	358	173	685	86	771
1968	133	99	328	158	718	56	774
1967	117	129	323	167	736	37	773
1966	143	127	526	167	963	41	1,004
1965	114	110	436	147	807	18	825
1964	107	107	429	146	789	3	792
1963	84	127	399	132	742	0[2/]	742
1962	97	64	387	131	679	0	679
1961	109	143	351	97	700	0	700
1960	128	181	431	70	810	0	810

(Table 27 continued on next page)

(Table 27 continued)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
				WISCONSIN			
1982	544	305	1,092	606	2,547	431	2,978
1981	488	307	1,182	666	2,643	511	3,154
1980	495	338	1,119	792	2,744	522	3,266
1979	544	274	999	727	2,544	524	3,068
1978	472	275	888	595	2,230	446	2,676
1977	402	292	915	564	2,173	424	2,597
1976	423	373	926	617	2,339	374	2,713
1975	377	419	791	376	1,963	381	2,344
1974	490	416	1,109	674	2,689	446	3,135
1973	387	410	1,005	466	2,268	428	2,696
1972	443	364	902	402	2,111	339	2,450
1971	514	375	1,011	348	2,248	333	2,581
1970	498	481	1,088	413	2,480	341	2,821
1969	456	426	978	341	2,201	313	2,514
1968	405	420	860	264	1,949	278	2,227
1967	416	590	1,116	349	2,471	259	2,730
1966	473	613	1,112	314	2,512	189	2,701
1965	410	553	899	245	2,107	183	2,290
1964	350	583	855	295	2,083	189	2,272
1963	414	653	877	299	2,243	187	2,430
1962	395	591	784	255	2,025	100	2,125
1961	330	637	741	240	1,948	24	1,972
1960	388	688	785	239	2,100	15	2,115
				MINNESOTA			
1982	140	228	785	57	1,210	90	1,300
1981	105	183	725	53	1,066	99	1,165
1980	99	228	613	47	987	110	1,097
1979	125	263	733	31	1,152	142	1,294
1978	147	240	647	33	1,067	150	1,217
1977	139	239	624	51	1,053	157	1,210
1976	131	220	599	75	1,025	153	1,178
1975	162	318	560	54	1,094	133	1,227
1974	185	244	718	77	1,224	168	1,392
1973	155	209	618	79	1,061	162	1,223
1972	166	197	686	77	1,126	98	1,224
1971	154	156	585	72	967	96	1,063
1970	188	153	557	64	962	96	1,058
1969	231	117	633	43	1,024	58	1,082
1968	206	126	576	27	935	58	993
1967	179	165	551	27	922	36	958
1966	207	215	587	32	1,041	21	1,062
1965	205	198	462	39	904	8	912
1964	213	221	455	43	932	6	938
1963	190	234	446	50	920	1	921
1962	189	185	418	36	828	0	828
1961	187	187	375	35	784	0	784
1960	164	204	408	11	787	0	787

1/ USDA Forest Service, Pulpwood Production in the North-Central Region by County.

2/ Less than 500 standard cords.

Table 28.--Pulpwood imports into Michigan, Wisconsin, and Minnesota by species group[1/]

(In thousand standard cords)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
			MICHIGAN				
1982	3	2	0[2/]	0[2/]	5	42	47
1981	3	3	0	0	6	40	46
1980	2	5	0	1	8	43	51
1979	3	12	1	1	17	45	62
1978	9	20	1	3	33	51	84
1977	15	24	1	3	43	31	74
1976	5	1	1	5	12	22	34
1975	2	4	3	3	12	17	29
1974	1	3	5	12	21	13	34
1973	1	3	5	29	38	30	68
1972	0	0	0	2	2	11	13
1971	0	1	0	0	1	11	12
1970	0	2	1	0	3	18	21
1969	0	1	2	0	3	15	18
1968	0	60	4	0	64	7	71
1967	0	82	4	0	86	4	90
1966	0	76	25	1	102	1	103
1965	0	64	10	0	74	0	74
1964	0	57	4	0	61	0	61
1963	0	68	5	0	73	0	73
1962	0	1	1	0	2	0	2
1961	0	71	0	0	71	0	71
1960	0	72	11	0	83	0	83
			WISCONSIN				
1982	80	114	226	114	534	212	746
1981	96	122	249	122	589	246	835
1980	129	152	264	156	701	267	968
1979	205	122	266	143	736	308	1,044
1978	142	131	233	112	618	279	897
1977	134	162	231	85	612	271	883
1976	154	208	245	85	692	236	928
1975	152	238	216	55	661	224	885
1974	214	255	318	80	867	264	1,131
1973	157	295	252	32	736	290	1,026
1972	197	259	242	30	728	230	958
1971	246	265	296	33	840	239	1,079
1970	239	339	322	46	946	248	1,194
1969	240	310	290	46	886	216	1,102
1968	206	309	243	27	785	183	968
1967	242	484	378	67	1,171	172	1,343
1966	257	468	310	40	1,075	125	1,200
1965	204	423	294	34	955	110	1,065
1964	183	449	269	39	940	123	1,063
1963	245	515	285	22	1,067	101	1,168
1962	208	481	228	35	952	59	1,011
1961	176	500	225	15	916	7	923
1960	265	562	263	14	1,104	3	1,107

(Table 28 continued on next page)

(Table 28 continued)

MINNESOTA

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
1982	6	4	18	1	29	5	34
1981	2	3	32	1	38	8	46
1980	0	7	18	0	25	28	53
1979	3	5	16	0	24	43	67
1978	2	4	12	0	18	45	63
1977	2	0	11	0	13	48	61
1976	2	0	11	0	13	55	68
1975	16	0	11	0	27	27	54
1974	19	0	6	6	31	64	95
1973	1	1	9	4	15	56	71
1972	0	1	35	6	42	13	55
1971	9	0	24	7	40	30	70
1970	38	2	9	7	56	20	76
1969	58	3	16	10	87	18	105
1968	48	3	21	6	78	14	92
1967	35	9	8	7	59	15	74
1966	8	65	10	0	83	10	93
1965	48	6	10	0	64	6	70
1964	48	7	24	0	79	3	82
1963	45	18	30	0	93	0	93
1962	43	7	25	0	75	0	75
1961	41	8	23	0	72	0	72
1960	39	7	29	0	75	0	75

1/ USDA Forest Service, Pulpwood Production in the North-Central Region by County.

2/ Less than 500 standard cords.

Table 29.--Pulpwood exports from Michigan, Wisconsin, and Minnesota by species group[1/]

(In thousand standard cords)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
			MICHIGAN				
1982	48	69	139	107	363	47	410
1981	50	67	167	111	395	41	436
1980	64	105	180	139	488	39	527
1979	127	79	184	138	528	26	554
1978	68	74	164	99	405	22	427
1977	68	91	163	81	403	33	436
1976	71	103	165	82	421	39	460
1975	68	129	150	52	399	67	466
1974	100	100	230	74	504	49	553
1973	70	88	204	40	402	52	454
1972	102	86	207	31	426	58	484
1971	120	90	249	33	492	72	564
1970	88	140	265	47	540	82	622
1969	91	112	250	47	500	51	551
1968	72	110	217	26	425	41	466
1967	76	179	327	44	626	34	660
1966	108	210	276	40	634	35	669
1965	110	160	278	34	582	33	615
1964	90	169	249	39	547	44	591
1963	90	215	269	22	596	33	629
1962	86	189	215	35	525	22	547
1961	47	188	208	14	457	21	478
1960	59	185	250	14	508	2	510
			WISCONSIN				
1982	9	3	18	2	32	23	55
1981	5	3	32	4	44	25	69
1980	3	5	18	4	30	34	64
1979	3	12	18	9	42	43	85
1978	9	25	14	11	59	57	116
1977	15	24	13	7	59	44	103
1976	5	1	12	8	26	30	56
1975	2	5	13	4	24	21	45
1974	1	2	6	16	25	25	50
1973	1	3	7	37	48	39	87
1972	0[2/]	0	25	8	33	11	44
1971	0	0	22	5	27	23	50
1970	0	0	5	4	9	21	30
1969	0	0	9	5	14	24	38
1968	0	0	12	4	16	22	38
1967	0	0	1	4	5	24	29
1966	0	0	7	8	15	20	35
1965	0	0	2	10	12	15	27
1964	1	0	17	8	26	11	37
1963	1	0	21	6	28	12	40
1962	0	0	16	9	25	1	26
1961	0	0	15	9	24	4	28
1960	1	0	18	6	25	20	45

(Table 29 continued on next page)

(Table 29 continued)

MINNESOTA

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total roundwood	Residue	All wood
1982	32	73	100	8	213	8	221
1981	33	90	108	12	243	9	252
1980	45	109	104	17	275	15	290
1979	32	53	121	7	213	19	232
1978	36	59	69	15	179	4	183
1977	33	59	84	4	180	4	184
1976	43	69	85	1	198	2	200
1975	45	69	68	3	185	1	186
1974	66	106	91	9	272	8	280
1973	51	104	63	4	222	2	224
1972	50	93	38	2	183	3	186
1971	69	85	47	0	201	5	206
1970	72	111	52	1	236	7	243
1969	64	101	43	2	210	5	215
1968	45	104	28	2	179	8	187
1967	58	177	49	2	286	15	301
1966	57	109	34	0	200	3	203
1965	25	132	16	2	175	3	178
1964	38	145	19	2	204	2	206
1963	63	154	16	1	234	0	234
1962	56	157	13	1	227	0	227
1961	59	179	17	1	256	0	256
1960	100	224	13	0	337	0	337

1/ USDA Forest Service, Pulpwood Production in the North-Central Region by County.

2/ Less than 500 standard cords.

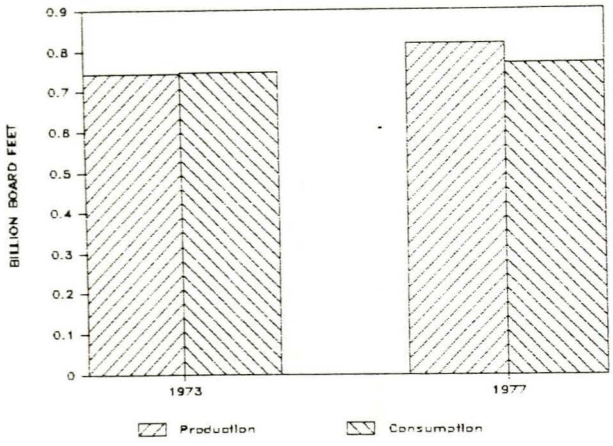

Figure 29.—*Hardwood lumber production and consumption in the Lake States.*

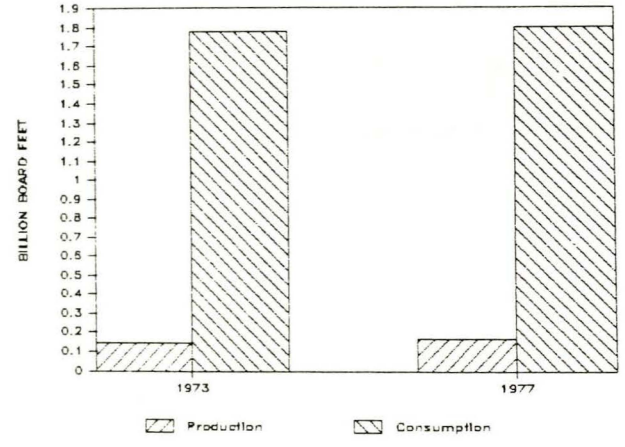

Figure 30.—*Softwood lumber production and consumption in the Lake States.*

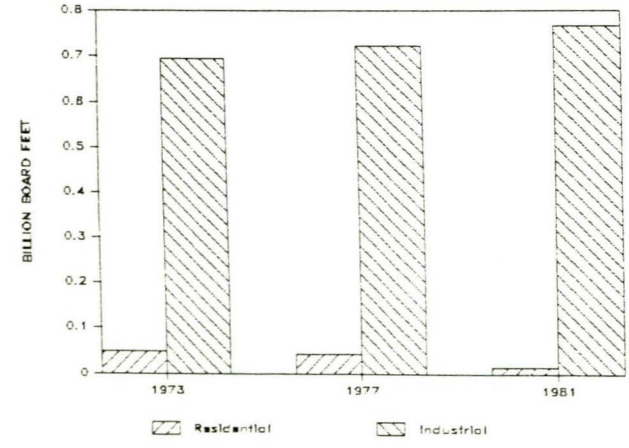

Figure 31.—*Hardwood lumber consumption in the Lake States by end use.*

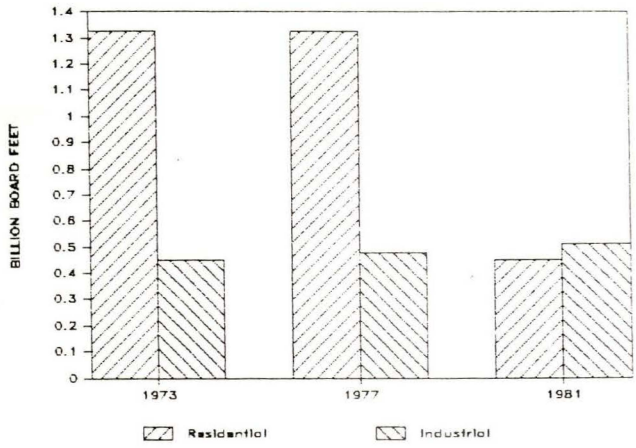

Figure 32.—*Softwood lumber consumption in the Lake States by end use.*

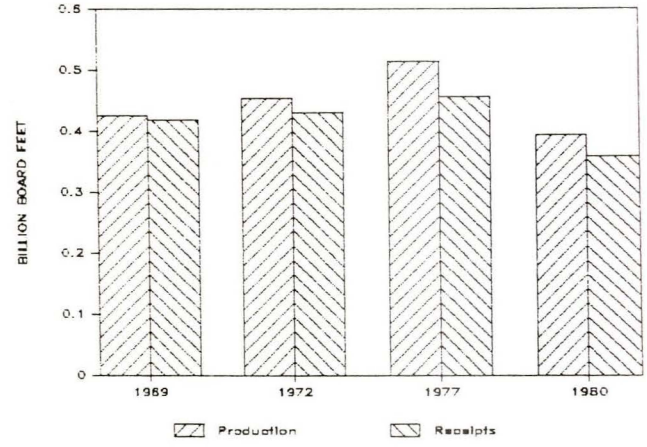

Figure 33.—*Saw log production and receipts in Michigan.*

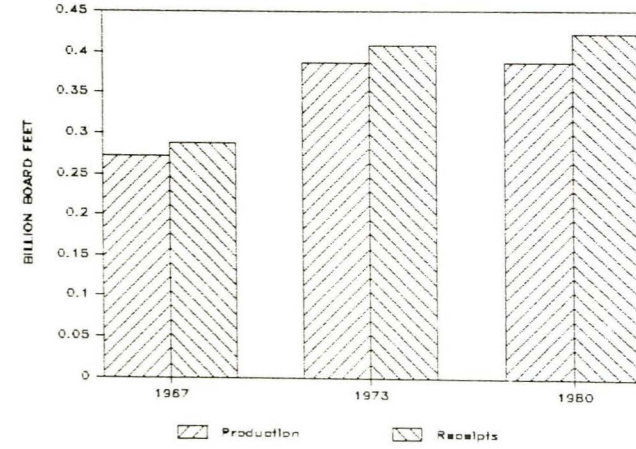

Figure 34.—*Saw log production and receipts in Wisconsin.*

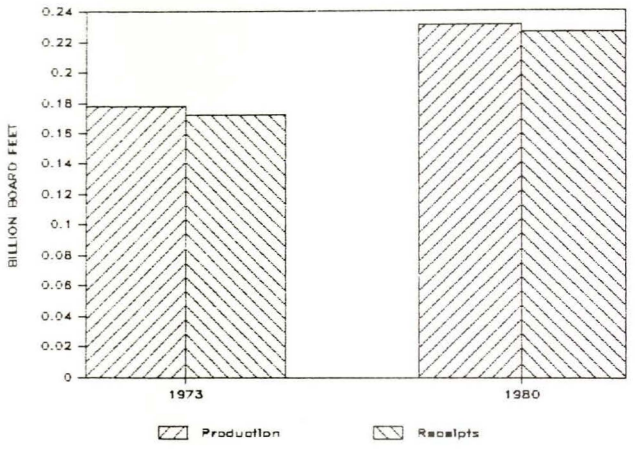

Figure 35.—*Saw log production and receipts in Minnesota.*

Table 30.--Lumber production in the Lake States, Michigan, and Wisconsin[1/]

(In million board feet, lumber tally)

Year	Softwood	Hardwood	Total[2/]
	LAKE STATES		
1979[3/]	182	831	1,014
1978	189	828	1,018
1977	168	816	984
1976	151	735	887
1975	141	666	807
1974	141	703	844
1973	145	754	899
1972	119	688	807
1971	116	685	802
1970	124	704	827
1969	158	656	814
1968	150	674	823
1967	131	654	785
1966	142	627	769
1965	142	644	786
1964	144	645	789
1963	190	547	737
1962		476	
1961		471	
	MICHIGAN		
1979[3/]	40	334	374
1978	39	326	365
1977	31	319	350
1976	37	297	334
1975	39	278	317
1974	37	314	351
1973	43	348	391
1972	39	347	386
1971	37	366	403
1970	42	365	407
1969	67	321	388
1968	64	335	399
1967	48	320	368
1966	54	295	349
1965	56	314	370
1964	63	314	377
1963	77	293	370
1962	42	231	273
1961	51	222	273
	WISCONSIN		
1979[3/]	81	418	499
1978	88	419	507
1977	78	416	494
1976	66	357	423
1975	56	314	370
1974	60	307	367
1973	57	320	377
1972	38	266	304
1971	39	234	273
1970	41	245	286
1969	46	241	287
1968	41	253	294
1967	42	244	286
1966	48	243	291
1965	50	249	299
1964	45	248	293
1963	78	178	256
1962	41	176	217
1961	39	189	228

[1/] U.S. Department of Commerce, Bureau of the Census, Current Industrial Report Series MA-24T.

[2/] Minnesota's production was estimated by taking a share of the production in the West North Central Division. See table 31.

[3/] State data was discontinued in the North Central Region after 1979.

Table 31.--Lumber production in Minnesota and West North Central division[1/]

(In million board feet, lumber tally)

Year	Softwood		Hardwood		Total	
	West North Central	Minnesota	West North Central	Minnesota	West North Central	Minnesota
1982	70		[3/]			
1981	75		[3/]			
1980	273	60	330	73	603	133
1979	279	61	360	79	639	141
1978	284	62	379	83	663	146
1977	270	59	367	81	637	140
1976	219	48	370	81	589	130
1975	210	46	337	74	547	120
1974	200	44	374	82	574	126
1973	205	45	392	86	597	131
1972	190	42	340	75	530	117
1971	183	40	388	85	571	126
1970	185	41	426	94	611	134
1969	203[2/]	45	427	94	630	139
1968	203[2/]	45	389	86	592	130
1967	188[2/]	45	407	90	595	131
1966	184[2/]	41	403	89	587	129
1965	165[2/]	40	367	81	532	117
1964	164[2/]	36	376	83	540	119
1963	159	35	344	76	503	111
1962	[3/]		314	69		
1961	[3/]		273	60		

[1/] Minnesota's production was not shown in U.S. Department of Commerce, Bureau of the Census, Current Industrial Report Series MA-24T. Therefore, this State's production was estimated by calculating its share of the production in the West North Central Division (U.S. Department of Commerce, Bureau of the Census, Manufacturers Series). The assumption was made that its production share equals its share of the value-added by manufacture in SIC 242, Sawmills and Planing Mills, within the same region, (i.e., about 22 percent).

[2/] Softwood production estimates for these years are below standard levels of consistency.

[3/] Suppressed data.

Table 32.--Residential construction in Michigan, Wisconsin, and Minnesota

Year	Construction permits[1]	Single-family		Multi-family	
	Thousand	Percent[1]	Thousand	Percent[2]	Thousand
			MICHIGAN		
1983	21.2	0.61	12.9	0.38	8.1
1982	14.3	.53	7.6	.44	6.3
1981	19.1	.58	11.1	.40	7.6
1980	29.8	.56	16.7	.42	12.5
1979	49.3	.63	31.1	.36	17.7
1978	61.1	.67	40.9	.33	20.2
1977	58.7	.67	39.3	.33	19.4
1976	45.9	.67	30.8	.33	15.1
1975	37.0	.70	25.9	.29	10.7
1974	44.3	.63	27.9	.36	15.9
1973	71.3	.64	45.6	.45	32.1
1972	76.6	.52	39.8	.47	36.0
			WISCONSIN		
1983	16.1	0.61	9.8	0.38	6.1
1982	12.3	.53	6.5	.44	5.4
1981	14.2	.58	8.2	.40	5.7
1980	18.5	.56	10.4	.42	7.8
1979	26.6	.63	16.8	.36	9.6
1978	37.7	.67	25.3	.33	12.4
1977	41.3	.67	27.7	.33	13.6
1976	35.3	.67	23.7	.33	11.6
1975	26.0	.70	18.2	.29	7.5
1974	26.0	.63	16.4	.36	9.4
1973	34.2	.64	21.9	.45	15.4
1972	36.3	.52	18.9	.47	17.1
			MINNESOTA		
1983	24.9	0.61	15.2	0.38	9.5
1982	19.0	.53	10.1	.44	8.4
1981	17.4	.58	10.1	.40	7.0
1980	21.7	.56	12.2	.42	9.1
1979	29.4	.63	18.5	.36	10.6
1978	37.8	.67	25.3	.33	12.5
1977	38.3	.67	25.7	.33	12.6
1976	27.0	.67	18.1	.33	8.9
1975	19.2	.70	13.4	.29	5.6
1974	20.6	.63	13.0	.36	7.4
1973	23.3	.64	14.9	.45	10.5
1972	37.3	.52	19.4	.47	17.5

[1] U.S. Department of Commerce, International Trade Administration. Data for 1978-1983 is from survey of 16,000 permit-issuing places. Data for 1972-1977 is from survey of 14,000 permit-issuing places. Comparisons of the data are reasonable.

[2] Assumes that Michigan, Wisconsin, and Minnesota's ratios for single- and multi-family home construction are the same as those in the North Central region.

Table 33.--Lumber used in single-family home construction in Michigan, Wisconsin, Minnesota, and the Lake States

Year	Construction permits[1]	Size	Softwood	Hardwood	Consumption		
					Softwood	Hardwood	Total
	Thousand	Thousand square feet	Board feet per square foot[2]		Million board feet		
MICHIGAN							
1981	11.1	1.70	6.60	0.24	124.5	4.5	129.1
1977	39.3	1.72	6.72	.24	454.2	16.2	470.5
1973	45.6	1.69	7.00	.30	539.4	23.1	562.6
WISCONSIN							
1981	8.2	1.70	6.60	0.24	92.0	3.3	95.3
1977	27.7	1.72	6.72	.24	320.2	11.4	331.6
1973	21.9	1.69	7.00	.30	259.1	11.1	270.2
MINNESOTA							
1981	10.1	1.70	6.60	0.24	113.3	4.1	117.4
1977	25.7	1.72	6.72	.24	297.1	10.6	307.7
1973	14.9	1.69	7.00	.30	176.3	7.6	183.8
LAKE STATES							
1981	29.4	1.70	6.60	0.24	329.9	12.0	341.9
1977	92.7	1.72	6.72	.24	1,071.5	38.3	1,109.7
1973	82.4	1.69	7.00	.30	974.8	41.8	1,016.6

[1] U.S. Department of Commerce, International Trade Administration.
[2] Spelter and Phelps (1984).

Table 34.--Lumber used in multi-family home construction in Michigan, Wisconsin, Minnesota, and the Lake States

Year	Construction permits[1]	Size	Softwood	Hardwood	Consumption		
					Softwood	Hardwood	Total
	Thousand	Thousand square feet	Board feet per square foot[2]		Million board feet		
MICHIGAN							
1981	7.6	0.97	4.45	0.04	32.8	0.3	33.1
1977	19.4	.94	4.81	.07	87.7	1.3	89.0
1973	32.1	1.05	4.43	.08	149.3	2.7	152.0
WISCONSIN							
1981	5.7	0.97	4.45	0.04	24.6	0.2	24.8
1977	13.6	.94	4.81	.07	61.5	.9	62.4
1973	15.4	1.05	4.43	.08	71.6	1.3	72.9
MINNESOTA							
1981	7.0	0.97	4.45	0.04	30.2	0.3	30.5
1977	12.6	.94	4.81	.07	57.0	.8	57.8
1973	10.5	1.05	4.43	.08	48.8	.9	49.7
LAKE STATES							
1981	20.3	0.97	4.45	0.04	87.6	0.8	88.4
1977	45.6	.94	4.81	.07	206.2	3.0	209.2
1973	58.0	1.05	4.43	.08	269.8	4.9	274.7

[1] U.S. Department of Commerce, International Trade Administration.
[2] Spelter and Phelps (1984).

Table 35.--Lumber used in new mobile homes in Michigan, Wisconsin, Minnesota, and the Lake States

Year	Shipments[1/]	Size	Softwood	Hardwood	Consumption		
					Softwood	Hardwood	Total
	Thousand	Thousand square feet	Board feet per square foot[2/]		Million board feet		
MICHIGAN							
1981	4.3	1.05	2.75	0.10	12.4	0.5	12.9
1977	7.5	1.00	2.69	.10	20.2	.8	20.9
1973	22.3	.88	2.40	.10	47.1	2.0	49.1
WISCONSIN							
1981	3.1	1.05	2.75	0.10	9.0	0.3	9.3
1977	5.0	1.00	2.69	.10	13.5	.5	14.0
1973	10.0	.88	2.40	.10	21.1	.9	22.0
MINNESOTA							
1981	4.0	1.05	2.75	0.10	11.6	0.4	12.0
1977	5.0	1.00	2.69	.10	13.5	.5	14.0
1973	6.7	.88	2.40	.10	14.2	.6	14.7
LAKE STATES							
1981	11.4	1.05	2.75	0.10	32.9	1.2	34.1
1977	17.5	1.00	2.69	.10	47.1	1.8	48.8
1973	39.0	.88	2.40	.10	82.4	3.4	85.8

[1/] U.S. Department of Commerce, International Trade Administration. Mobile home shipments to Minnesota are estimated from shipments to the North Central region, assuming that the State's share is the same as its share of residential construction within the region.

[2/] Spelter and Phelps (1984).

Table 36.--Lumber used in residential alterations and repairs in Michigan, Wisconsin, Minnesota, and the Lake States

Year	Valuation[1]			Softwood 1977[2]	Consumption
	Nominal	CPI	1977		Softwood
	Million dollars		Million dollars	Board feet per dollar	Million board feet
MICHIGAN					
1983	160.9	0.612	98.5	0.21	20.7
1982	138.5	.628	87.0	.21	18.3
1981	171.5	.665	114.0	.21	23.9
1980	203.6	.736	149.8	.21	31.5
1979	209.3	.836	175.0	.20	35.0
1978	173.3	.929	161.0	.20	32.2
WISCONSIN					
1983	131.7	0.612	80.6	0.21	16.9
1982	125.9	.628	79.1	.21	16.6
1981	122.5	.665	81.5	.21	17.1
1980	122.1	.736	89.9	.21	18.9
1979	110.8	.836	92.6	.20	18.5
1978	108.3	.929	100.6	.20	20.1
MINNESOTA					
1983	190.2	0.612	116.4	0.21	24.4
1982	188.9	.628	118.6	.21	24.9
1981	159.3	.665	105.9	.21	22.2
1980	149.3	.736	109.9	.21	23.1
1979	123.1	.836	102.9	.20	20.6
1978	108.3	.929	100.6	.20	20.1
LAKE STATES					
1983	482.8	0.612	295.5	0.21	62.0
1982	453.3	.628	284.7	.21	59.8
1981	453.3	.665	301.4	.21	63.3
1980	475.0	.736	349.6	.21	73.4
1979	443.2	.836	370.5	.20	74.1
1978	389.9	.929	362.2	.20	72.4

[1] U.S. Department of Commerce, International Trade Administration. Based on valuation of residential alterations and repairs in the North Central Region. Assumes each State's share of the region's residential permits is the same as its share of the region's alterations and repairs.

[2] Spelter and Phelps (1984).

Table 37.--Lumber used in nonresidential building construction in Michigan, Wisconsin, Minnesota, and the Lake States

Year	Construction value[1]			1977[2]		Consumption		
	Nominal	CPI	1977	Softwood	Hardwood	Softwood	Hardwood	Total
	Million dollars		Million dollars	Board feet per dollar		Million board feet		
MICHIGAN								
1983	1,191	0.612	729	0.03	0.005	21.9	3.6	25.5
1982	1,092	.628	686	.03	.005	20.6	3.4	24.0
1981	1,439	.665	957	.03	.005	28.7	4.8	33.5
1980	1,631	.736	1,200	.03	.005	36.0	6.0	42.0
1979	1,619	.836	1,353	.03	.006	40.6	8.1	48.7
1978	1,391	.929	1,292	.03	.006	38.8	7.8	46.5
WISCONSIN								
1983	685	0.612	419	0.03	0.005	12.6	2.1	14.7
1982	634	.628	398	.03	.005	11.9	2.0	13.9
1981	777	.665	517	.03	.005	15.5	2.6	18.1
1980	805	.736	592	.03	.005	17.8	3.0	20.7
1979	883	.836	738	.03	.006	22.1	4.4	26.6
1978	741	.929	688	.03	.006	20.7	4.1	24.8
MINNESOTA								
1983	1,048	0.612	641	0.03	0.005	19.2	3.2	22.4
1982	1,006	.628	632	.03	.005	19.0	3.2	22.1
1981	962	.665	640	.03	.005	19.2	3.2	22.4
1980	1,029	.736	757	.03	.005	22.7	3.8	26.5
1979	1,171	.836	979	.03	.006	29.4	5.9	35.2
1978	1,026	.929	953	.03	.006	28.6	5.7	34.3
LAKE STATES								
1983	2,924	0.612	1,789	0.03	0.005	53.7	8.9	62.6
1982	2,732	.628	1,716	.03	.005	51.5	8.6	60.0
1981	3,178	.665	2,113	.03	.005	63.4	10.6	74.0
1980	3,465	.736	2,550	.03	.005	76.5	12.8	89.3
1979	3,673	.836	3,070	.03	.006	92.1	18.4	110.5
1978	3,158	.929	2,933	.03	.006	88.0	17.6	105.6

[1] Based on U.S. Department of Commerce, International Trade Administration Includes nonresidential alterations and repairs.

[2] Spelter and Phelps (1984).

Table 38.--Lumber used in pallet manufacturing in Michigan, Wisconsin, Minnesota, and the Lake States

Year	U.S. consumption[1/]		State(s) share[2/]	State consumption		
	Softwood	Hardwood		Softwood	Hardwood	Total
	Million board feet		Percent	Million board feet		
			MICHIGAN			
1981	1,000	2,510	8.0	80.0	200.8	280.8
1977	970	2,290	8.6	83.4	196.9	280.4
1973	800	2,000	9.9	79.2	198.0	277.2
			WISCONSIN			
1981	1,000	2,510	6.0	60.0	150.6	210.6
1977	970	2,290	5.6	54.3	128.2	182.6
1973	800	2,000	4.3	34.4	86.0	120.4
			MINNESOTA			
1981	1,000	2,510	1.3	13.0	32.6	45.6
1977	970	2,290	1.3	12.6	29.8	42.4
1973	800	2,000	1.3	10.4	26.0	36.4
			LAKE STATES			
1981	1,000	2,510	15.3	153.0	384.0	537.0
1977	970	2,290	15.5	150.4	355.0	505.3
1973	800	2,000	15.5	124.0	310.0	434.0

1/ Spelter and Phelps (1984).
2/ U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes that the State's share of value-added in SIC 2448, wood pallets and skids, represents its share of the nation's total lumber consumption in pallet manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 39.--Lumber used in container and dunnage manufacturing in Michigan, Wisconsin, Minnesota, and the Lake States

Year	U.S. consumption[1/]		State(s) share[2/]	State consumption		
	Softwood	Hardwood		Softwood	Hardwood	Total
	Million board feet		Percent	Million board feet		
			MICHIGAN			
1981	650	570	6.2	40.3	35.3	75.6
1977	650	590	6.4	41.6	37.8	79.4
1973	940	800	6.6	62.0	52.8	114.8
			WISCONSIN			
1981	650	2,510	2.9	18.9	72.8	91.6
1977	650	2,290	2.8	18.2	64.1	82.3
1973	940	2,000	2.7	25.4	54.0	79.4
			MINNESOTA			
1981	650	570	1.6	10.4	9.1	19.5
1977	650	590	1.6	10.4	9.4	19.8
1973	940	800	1.6	15.0	12.8	27.8
			LAKE STATES			
1981	650	570	10.7	69.6	117.3	186.8
1977	650	590	10.8	70.2	111.3	181.5
1973	940	800	10.9	102.5	119.6	222.1

1/ Spelter and Phelps (1984).
2/ U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes that the State's share of value-added in all U.S. manufacturing industries represents its share of the nation's total lumber consumption in container and dunnage manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 40.--Lumber used in furniture manufacturing in Michigan, Wisconsin, Minnesota, and the Lake States

Year	U.S. consumption[1/]		State(s) share[2/]	State consumption		
	Softwood	Hardwood		Softwood	Hardwood	Total
	Million board feet		Percent	Million board feet		
MICHIGAN						
1981	1,380	1,840	8.0	110.4	147.2	257.6
1977	1,280	1,870	7.5	96.0	140.3	236.3
1973	1,210	2,260	6.0	72.6	135.6	208.2
WISCONSIN						
1981	1,380	1,840	2.5	34.5	46.0	80.5
1977	1,280	1,870	2.4	30.7	44.9	75.6
1973	1,210	2,260	2.1	25.4	47.5	72.9
MINNESOTA						
1981	1,380	1,840	1.0	13.8	18.4	32.2
1977	1,280	1,870	1.0	12.8	18.7	31.5
1973	1,210	2,260	.9	10.9	20.3	31.2
LAKE STATES						
1981	1,380	1,840	11.5	158.7	211.6	370.3
1977	1,280	1,870	10.9	139.5	203.8	343.3
1973	1,210	2,260	9.0	108.9	203.4	312.3

1/ Spelter and Phelps (1984).
2/ U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes that the State's share of value-added in SIC 25, furniture and fixtures, represents its share of the nation's total lumber consumption in furniture manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 41.--Lumber used in other manufacturing in Michigan, Wisconsin, Minnesota, and the Lake States

Year	U.S. consumption[1/]		State(s) share[2/]	State consumption		
	Softwood	Hardwood		Softwood	Hardwood	Total
	Million board feet		Percent	Million board feet		
MICHIGAN						
1981	1,170	510	6.2	72.5	31.6	104.2
1977	1,090	500	6.4	69.8	32.0	101.8
1973	1,050	580	6.6	69.3	38.3	107.6
WISCONSIN						
1981	1,170	510	2.9	33.9	14.8	48.7
1977	1,090	500	2.8	30.5	14.0	44.5
1973	1,050	580	2.7	28.4	15.7	44.0
MINNESOTA						
1981	1,170	510	1.6	18.7	8.2	26.9
1977	1,090	500	1.6	17.4	8.0	25.4
1973	1,050	580	1.6	16.8	9.3	26.1
LAKE STATES						
1981	1,170	510	10.7	125.2	54.6	179.8
1977	1,090	500	10.8	117.7	54.0	171.7
1973	1,050	580	10.9	114.5	63.2	177.7

1/ Spelter and Phelps (1984).
2/ U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes that the State's share of value-added in all U.S. manufacturing industries, represents its share of the nation's total lumber consumption in container and dunnage manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 42.--Saw log production in Michigan, Wisconsin, and Minnesota by state of destination[1/]

(All species, million board feet, international 1/4-inch)

Year	Destination[2/]									
	Michigan	Wisconsin	Minnesota	Indiana	Kentucky	Ohio	Iowa	Missouri	Other[2/]	Total
					MICHIGAN					
1980	357.5	29.2	0.0[3/]	5.6	0.3	0.0				392.6
1978	520.0	39.4	.0	3.9	.0	.0				563.3
1977	454.2	55.7	.0	4.0	.0	.1				514.0
1975	331.4	25.0	.0	2.8	.1	.0				359.3
1972	427.0	24.5	.0	2.9	.0	.0				454.4
1969	417.6	8.1	.0	.3	.0	.1				426.1
					WISCONSIN					
1981	0.8	490.0	0.0				0.0		0.^	490.8
1980	1.4	385.4	.2				.0		.3	387.3
1975	3.6	329.5	.0				.6		1.0	334.7
1973	1.5	382.8	.5				.9		.8	386.5
					MINNESOTA					
1980	0.0	3.0	225.2				2.5	0.0		230.7
1975	.0	3.6	152.4				.0	.1		156.1
1973	.0	7.0	170.3				.1	.2		177.5

1/ USDA Forest Service, Primary Forest Products Industry and Timber Use, (North Central Region series).

2/ Other states that receive Michigan, Wisconsin, and Minnesota exports include Indiana, Illinois, Kentucky, and other Central States.

3/ Less than 50 thousand board feet.

Table 43.--Saw log production in Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, international 1/4-inch)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total
			MICHIGAN		
1980	13.1	33.6	73.4	272.6	392.7
1978	23.0	42.1	127.1	371.1	563.3
1977	37.7	53.8	98.4	324.1	514.0
1975	14.7	35.2	63.2	246.1	359.2
1972	12.5	46.8	64.0	331.1	454.4
1969	7.3	43.9	43.1	331.8	426.1
1965	6.0	32.9	35.7	312.9	387.5
			WISCONSIN		
1981	19.7	56.0	76.4	338.7	490.8
1980	16.6	50.6	57.2	262.9	387.3
1975	16.8	46.4	50.1	221.3	334.6
1973	11.3	32.3	74.3	268.6	386.5
1967	4.1	24.6	30.7	213.1	272.5
			MINNESOTA		
1980	50.3	28.5	80.8	71.1	230.7
1975	39.8	21.1	49.5	45.7	156.1
1973	25.8	29.4	60.7	61.6	177.5
1960	39.6	36.5	37.6	54.4	168.1

[1/] USDA Forest Service, Primary Forest Products Industry and Timber Use, North Central Region series.

Table 44.--Saw log receipts in Michigan, Wisconsin, and Minnesota by state of origin[1/]

(All species, million board feet, international 1/4-inch)

Year	Origin						
	Michigan	Wisconsin	Minnesota	Ohio	Iowa	Indiana	Total
				MICHIGAN			
1980	357.5	1.4	0.0[2/]	0.0		0.0	358.9
1978	520.0	4.4	.0	1.0		.0	525.4
1977	454.2	1.6	.0	1.3		.0	457.1
1972	427.0	1.9	.0	.0		.7	429.6
1969	417.6	.2	.0	.0		.4	418.2
				WISCONSIN			
1981	39.4	490.0	8.6		0.8		538.9[3/]
1980	29.2	385.4	3.0		5.0		422.6
1973	17.9	382.8	6.9		.7		408.3
				MINNESOTA			
1980	0.0	0.2	225.2		0.9		226.3
1973	.0	.4	170.3		1.6		172.2

[1/] USDA Forest Service, Primary Forest Products Industry and Timber Use, North Central Region series.

[2/] Less than 50 thousand board feet.

[3/] Wisconsin also receives some saw logs from Illinois and Canada.

Table 45.--Saw log receipts in Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, international 1/4-inch)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total
			MICHIGAN		
1980	9.7	26.1	64.9	258.2	358.9
1978	15.6	34.2	108.6	366.9	525.3
1977	26.1	34.5	81.7	314.8	457.1
1972	11.3	44.2	49.5	324.6	429.6
1969	7.1	43.0	38.5	329.7	418.3
			WISCONSIN		
1981	23.4	65.7	88.7	361.0	538.9
1980	20.1	58.6	65.8	278.2	422.6
1973	14.7	36.4	82.2	275.0	408.3
1967	4.1	26.1	34.9	292.8	288.0
			MINNESOTA		
1980	50.0	28.2	80.9	67.2	226.3
1973	25.3	28.0	60.5	58.4	172.2

[1/] USDA Forest Service, Primary Forest Products Industry and Timber Use, North Central Region series.

Table 46.--Saw log imports into Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, international 1/4-inch)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total
			MICHIGAN		
1980	0.0[2/]	0.0	0.6	0.8	1.4
1978	.0	.4	.4	4.6	5.4
1977	.0	.2	.5	2.2	2.9
1972	.3	.7	.1	1.5	2.6
1969	.0	.2	.0	.4	.6
			WISCONSIN		
1981	3.8	9.6	12.4	23.0	48.8
1980	3.6	7.9	9.4	16.4	37.2
1973	3.5	4.5	7.9	9.7	25.6
			MINNESOTA		
1980	0.0	0.0	0.2	0.9	1.1

[1/] USDA Forest Service, Primary Forest Products Industry and Timber Use, North Central Region series.

[2/] Less than 50 thousand board feet.

Table 47.--Saw log exports from Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, international 1/4-inch)

Year	Hard pine	Other softwoods	Aspen	Other hardwoods	Total
			MICHIGAN		
1980	3.3	7.6	9.1	15.1	35.1
1978	7.4	8.3	18.9	8.8	43.4
1977	11.6	19.5	17.2	11.5	59.8
1975	1.1	1.2	14.7	11.4	28.4
1972	1.6	3.2	14.3	8.4	27.5
1969	.1	1.2	4.7	2.4	8.4
			WISCONSIN		
1981	0.0[2/]	0.0	0.1	0.7	0.8
1980	.0	.0	.8	1.1	1.9
1975	.5	.8	.2	3.7	5.2
1973	.0	.5	.0	3.3	3.7
			MINNESOTA		
1980	0.3	0.3	0.1	4.8	5.5
1975	1.1	.5	.1	2.0	3.7
1973	.6	1.7	.2	4.8	7.3

[1/] USDA Forest Service, Primary Forest Products Industry and Timber Use, North Central Region series.

[2/] Less than 50 thousand board feet.

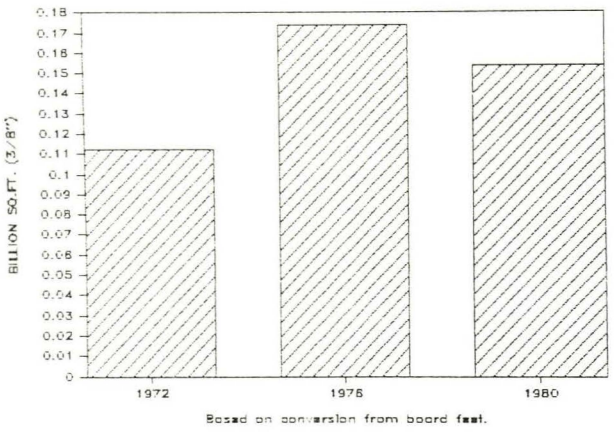

Figure 36.—*Hardwood veneer log receipts in the Lake States.*

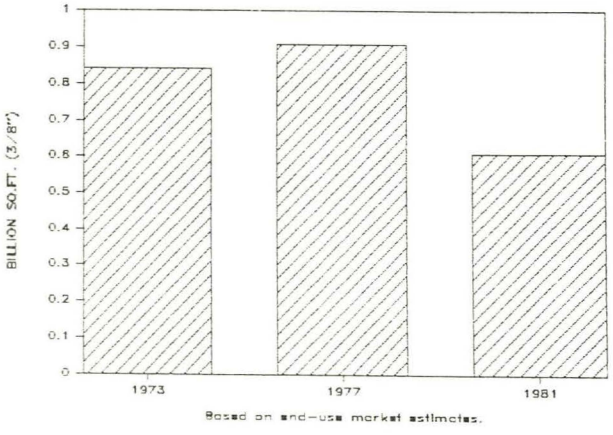

Figure 37.—*Plywood and veneer consumption in the Lake States.*

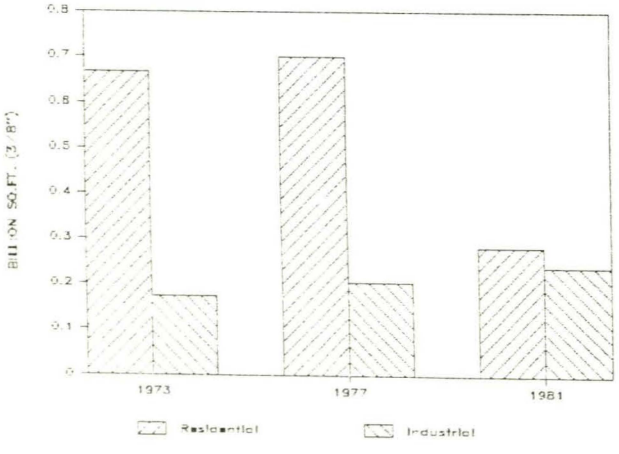

Figure 38.—*Lake States plywood and veneer consumption by end use.*

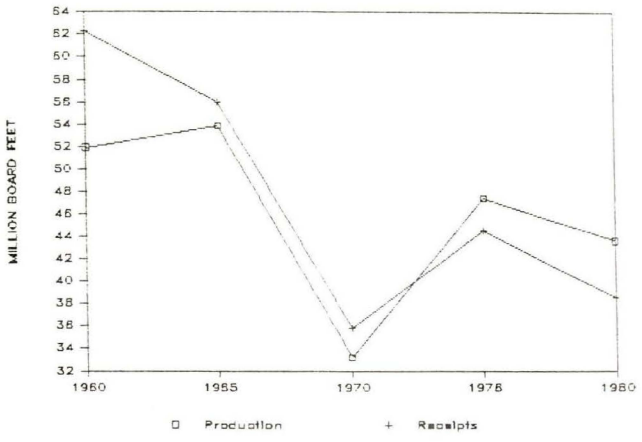

Figure 39.—*Veneer log production and receipts in the Lake States.*

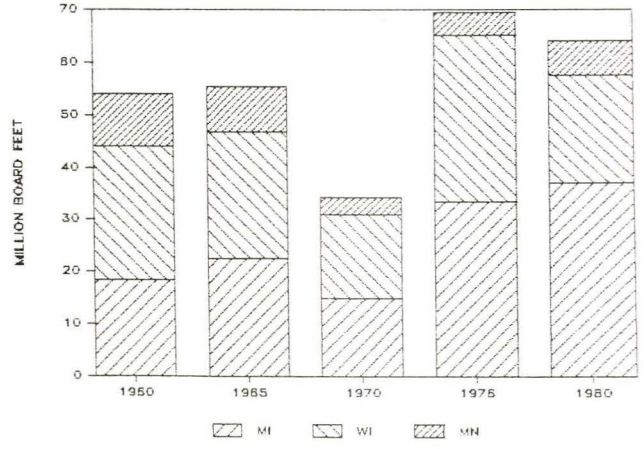

Figure 40.—*Veneer log production in the Lake States.*

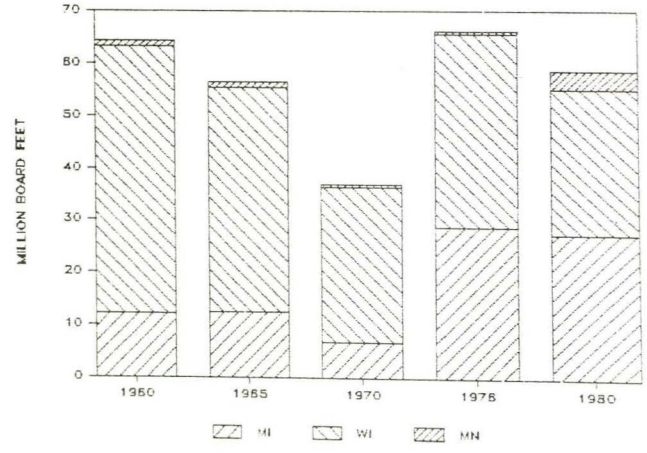

Figure 41.—*Veneer log receipts in the Lake States.*

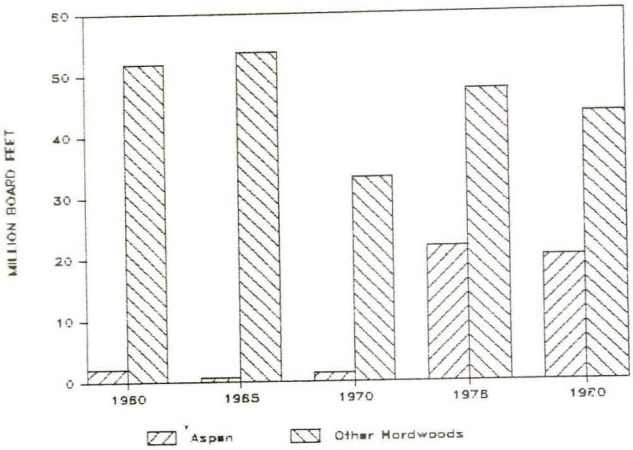

Figure 42.—*Veneer log production in the Lake States by species groups.*

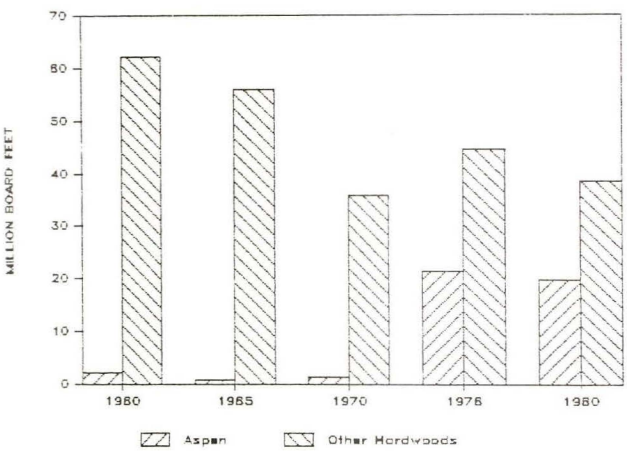

Figure 43.—*Veneer log receipts in the Lake States by species groups.*

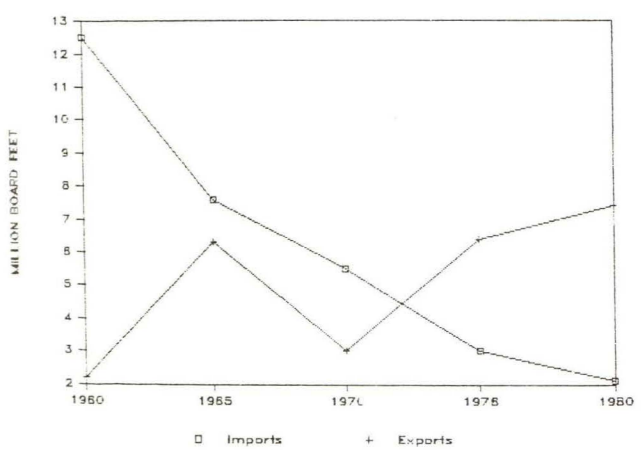

Figure 44.—*Lake States veneer log imports and exports.*

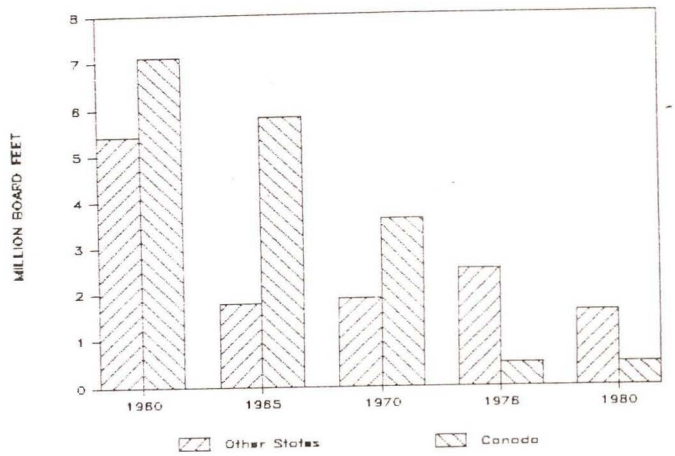

Figure 45.—*Veneer log imports to the Lake States from other states and Canada.*

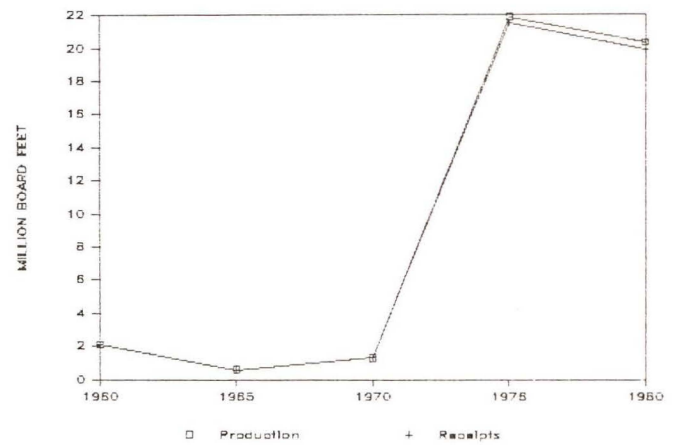

Figure 46.—*Production and receipts of aspen veneer logs in the Lake States.*

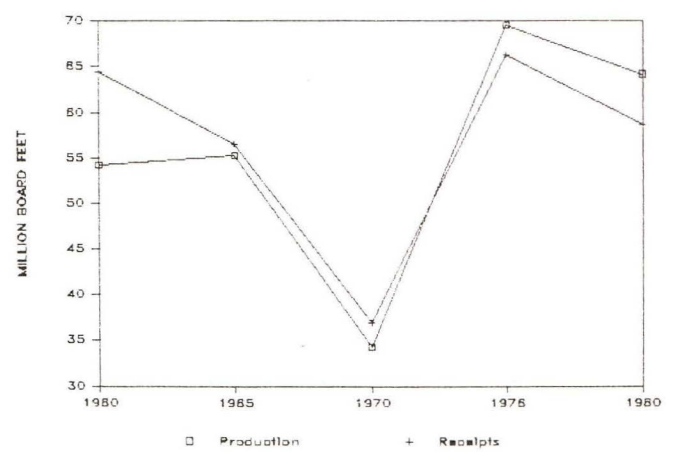

Figure 47.—*Production and receipts of other hardwood veneer logs in the Lake States.*

Table 48.--Hardwood veneer log receipts in the Lake States[1/]

(In million square feet, 3/8-inch)

Year	Aspen	Other	Total
1980	52.5	101.6	154.2
1976	56.8	117.5	174.2
1972	6.3	105.3	111.7
1970	3.4	94.5	97.9
1968	1.6	124.1	125.7
1966	1.8	144.1	146.0
1965	1.6	147.8	149.4
1963	4.0	135.2	139.2
1960	5.5	164.5	170.0

1/ USDA Forest Service, Veneer Log Production and Receipts, North Central Region. Figures obtained by converting board feet to square feet using conversion factor 2,640 square feet (3/8-inch) per 1,000 board feet (Internationl 1/4-inch).

Table 49.--Plywood used in single-family home construction in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	Construction permits[1/]	Square feet per home[2/]	Total
	Thousand		Million square feet
LAKE STATES			
1981	34.5	5.84	201.5
1977	92.7	5.82	539.5
1973	82.4	5.67	467.2
MICHIGAN			
1981	11.1	5.84	64.8
1977	39.3	5.82	228.7
1973	45.6	5.67	258.6
WISCONSIN			
1981	8.2	5.84	47.9
1977	27.7	5.82	161.2
1973	21.9	5.67	124.2
MINNESOTA			
1981	15.2	5.84	88.8
1977	25.7	5.82	149.6
1973	14.9	5.67	84.5

1/ U.S. Department of Commerce, International Trade Administration.

2/ Based on interpolations, USDA Forest Service (1982).

Table 50.--Plywood used in multi-family home construction in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	Construction permits[1]	Square feet per home[2]	Total
	Thousand		Million square feet
LAKE STATES			
1981	20.3	2.92	59.3
1977	45.6	2.93	133.6
1973	58.0	2.50	145.0
MICHIGAN			
1981	7.6	2.92	22.2
1977	19.4	2.93	56.8
1973	32.1	2.50	80.3
WISCONSIN			
1981	5.7	2.92	16.6
1977	13.6	2.93	39.8
1973	15.4	2.50	38.5
MINNESOTA			
1981	7.0	2.92	20.4
1977	12.6	2.93	36.9
1973	10.5	2.50	26.3

[1] U.S. Department of Commerce, International Trade Administration.

[2] Based on interpolations, USDA Forest Service (1982).

Table 51.--Plywood used in new mobile homes in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	Shipments[1]	Square feet per home[2]	Total
	Thousand		Million square feet
LAKE STATES			
1981	11.4	1.83	20.9
1977	17.5	1.65	28.9
1973	39.0	1.45	56.6
MICHIGAN			
1981	4.3	1.83	7.9
1977	7.5	1.65	12.4
1973	22.3	1.45	32.3
WISCONSIN			
1981	3.1	1.83	5.7
1977	5.0	1.65	8.3
1973	10.0	1.45	14.5
MINNESOTA			
1981	4.0	1.83	7.3
1977	5.0	1.65	8.3
1973	6.7	1.45	9.7

[1] U.S. Department of Commerce, International Trade Administration. Mobile home shipments to the State are estimated from shipments to the North Central region, assuming the State's share is the same as its share of residential construction within the region.

[2] Based on interpolations, USDA Forest Service (1982).

Table 52.--Plywood used in residential alterations and repairs in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	Valuation[1/]			1972[2/]	Consumption
	Nominal	CPI	1972		
	Million dollars		Million dollars	Square feet per dollar	Million square feet
LAKE STATES					
1983	482.8	0.422	203.7	0.162	33.0
1982	453.3	.433	196.3	.163	32.0
1981	453.3	.459	208.1	.163	33.9
1980	475.0	.508	241.3	.164	39.6
1979	443.2	.577	255.7	.164	41.9
1978	389.9	.641	249.9	.165	41.2
MICHIGAN					
1983	160.9	0.422	67.9	0.162	11.0
1982	138.5	.433	60.0	.163	9.8
1981	171.5	.459	78.7	.163	12.8
1980	203.6	.508	103.4	.164	17.0
1979	209.3	.577	120.8	.164	19.8
1978	173.3	.641	111.1	.165	18.3
WISCONSIN					
1983	131.7	0.422	55.6	0.162	9.0
1982	125.9	.433	54.5	.163	8.9
1981	122.5	.459	56.2	.163	9.2
1980	122.1	.508	62.0	.164	10.2
1979	110.8	.577	63.9	.164	10.5
1978	108.3	.641	69.4	.165	11.5
MINNESOTA					
1983	190.2	0.422	80.3	0.162	13.0
1982	188.9	.433	81.8	.163	13.3
1981	159.3	.459	73.1	.163	11.9
1980	149.3	.508	75.8	.164	12.4
1979	123.1	.577	71.0	.164	11.6
1978	108.3	.641	69.4	.165	11.5

[1/] U.S. Department of Commerce, International Trade Administration. Based on valuation of residential alterations and repairs in the North Central Region. Assumes each State's share of the region's residential permits is the same as its share of the region's alterations and repairs.

[2/] Based on interpolations, USDA Forest Service (1982).

Table 53.--Plywood used in nonresidential building construction in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	Construction value[1]			1972[2]	Consumption
	Nominal	CPI	1972		
	Million dollars		Million dollars	Square feet per dollar	Million square feet
LAKE STATES					
1983	2,924	0.422	1,233.9	0.039	48.1
1982	2,732	.433	1,183.0	.039	46.1
1981	3,180	.459	1,459.6	.038	55.5
1980	3,465	.508	1,760.2	.038	66.9
1979	3,673	.577	2,119.3	.037	78.4
1978	3,158	.641	2,024.3	.037	74.9
MICHIGAN					
1983	1,191	0.422	502.6	0.039	19.6
1982	1,092	.433	472.8	.039	18.4
1981	1,439	.459	660.5	.038	25.1
1980	1,631	.508	828.5	.038	31.5
1979	1,619	.577	934.2	.037	34.6
1978	1,391	.641	891.6	.037	33.0
WISCONSIN					
1983	685	0.422	289.1	0.039	11.3
1982	634	.433	274.5	.039	10.7
1981	779	.459	357.6	.038	13.6
1980	805	.508	408.9	.038	15.5
1979	883	.577	509.5	.037	18.9
1978	741	.641	475.0	.037	17.6
MINNESOTA					
1983	1,048	0.422	442.3	0.039	17.2
1982	1,006	.433	435.6	.039	17.0
1981	962	.459	441.6	.038	16.8
1980	1,029	.508	522.7	.038	19.9
1979	1,171	.577	675.7	.037	25.0
1978	1,026	.641	657.7	.037	24.3

[1] U.S. Department of Commerce, International Trade Administration.

[2] Based on interpolations, USDA Forest Service (1982).

Table 54.--Plywood and veneer used in furniture manufacturing in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	U.S. consumption[1]	State share[2]	State consumption
	Million square feet	Percent	Million square feet
		LAKE STATES	
1981	1,017	11.5	117.0
1977	939	10.9	102.4
1973	993	9.0	89.4
		MICHIGAN	
1981	1,017	8.0	81.4
1977	939	7.5	70.4
1973	993	6.0	59.6
		WISCONSIN	
1981	1,017	2.5	25.4
1977	939	2.4	22.5
1973	993	2.1	20.9
		MINNESOTA	
1981	1,017	1.0	10.2
1977	939	1.0	9.4
1973	993	.9	8.9

[1] Based on interpolations, USDA Forest Service (1982).

[2] U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes the State's share of value-added in SIC 25, Furniture and Fixtures, represents its share of the nation's total plywood and veneer consumption in furniture manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 55.--Plywood and veneer used in pallet manufacturing in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	U.S. consumption[1]	State share[2]	State consumption
	Million square feet	Percent	Million square feet
		LAKE STATES	
1981	557	15.3	85.2
1977	431	15.5	66.8
1973	270	15.5	41.9
		MICHIGAN	
1981	557	8.0	44.6
1977	431	8.6	37.1
1973	270	9.9	26.7
		WISCONSIN	
1981	557	6.0	33.4
1977	431	5.6	24.1
1973	270	4.3	11.6
		MINNESOTA	
1981	557	1.3	7.2
1977	431	1.3	5.6
1973	270	1.3	3.5

[1] Based on interpolations, USDA Forest Service (1982).

[2] U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes the State's share of SIC 2448, Wood pallets and skids, represents its share of the nation's total plywood and veneer consumption in pallet manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 56.--Plywood and veneer used in container and dunnage manufacturing in the Lake States, Michigan, Wisconsin, and Minnesota

(In 3/8-inch basis)

Year	U.S. consumption[1/]	State share[2/]	State consumption
	Million square feet	Percent	Million square feet
		LAKE STATES	
1981	323	10.7	34.6
1977	335	10.8	36.2
1973	374	10.9	40.8
		MICHIGAN	
1981	323	6.2	20.0
1977	335	6.4	21.4
1973	374	6.6	24.7
		WISCONSIN	
1981	323	2.9	9.4
1977	335	2.8	9.4
1973	374	2.7	10.1
		MINNESOTA	
1981	323	1.6	5.2
1977	335	1.6	5.4
1973	374	1.6	6.0

1/ Based on interpolations, USDA Forest Service (1982).

2/ U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes that the State's share of value-added in all U.S. manufacturing industries represents its share of the nation's total plywood and veneer consumption in container and dunnage manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 57.--Veneer log production in the Lake States[1/]

(All species, MMBF, international 1/4-inch)

Year	Michigan	Wisconsin	Minnesota	Total
1981		27.3		
1980	36.8	20.9	6.5	64.2
1978	35.2			
1977	42.8			
1976	33.4	31.7	4.5	69.6
1975	26.0	31.7	3.2	60.9
1973		32.2	5.2	
1972	18.6	19.5	4.2	42.3
1970	15.0	15.8	3.5	34.3
1969	19.2			
1968	19.3	21.1	5.2	45.6
1966	21.9	22.9	6.0	50.8
1965	22.4	24.4	8.5	55.3
1963	15.3	25.2	9.9	50.4
1960	18.5	25.5	10.2	54.2

1/ USDA Forest Service, veneer log production and receipts, North Central Region.

Table 58.--Veneer log receipts in the Lake States[1/]

(All species, MMBF, international 1/4-inch)

Year	Michigan	Wisconsin	Minnesota	Total
1981		34.5		
1980	27.3	27.9	3.5	58.7
1978	39.2			
1977	30.8			
1976	28.7	37.0	.6	66.3
1973		37.8		
1972	5.4	36.6	.5	42.5
1970	6.7	29.8	.4	36.9
1969	15.1			
1968	9.6	37.6	.5	47.7
1966	13.0	42.2	.5	55.7
1965	12.4	43.0	1.1	56.5
1963	7.6	41.8	3.2	52.6
1962		37.6		
1960	12.1	51.3	1.1	64.5

1/ USDA Forest Service, veneer log production and receipts, North Central Region.

Table 59.--Veneer log imports and exports in the Lake States[1/]

(In million board feet, international 1/4-inch)

Year	Imports			Exports
	Other States	Canada	Total	Outside region
1980	1.6	0.5	2.1	7.4
1976	2.5	.5	3.0	6.4
1975				2.0
1972	1.6	3.1	4.7	4.6
1970	1.9	3.6	5.5	3.0
1968	3.0	4.9	7.9	5.9
1966	2.8	7.0	9.8	5.0
1965	1.8	5.8	7.6	6.3
1963	1.9	5.8	7.7	5.6
1962	2.8	4.8	7.6	
1960	5.4	7.1	12.5	2.2

1/ USDA Forest Service, veneer log production and receipts, North Central Region.

Table 60.--Veneer log production in Michigan, Wisconsin, and Minnesota by state of destination[1/]

(All species, million board feet, international 1/4-inch)

Year	Destination								Total
	Michigan	Wisconsin	Minnesota[2/]	Indiana	Ohio	Kentucky	Other[3/] States	Canada	
MICHIGAN									
1980	22.1	9.0	0.0[4/]				5.6[5/]		36.8
1978	22.6	8.7	.0	1.5	0.3	0.1	1.2	0.8	35.2
1977	30.4	8.5	.0	2.3	.3	.5	.0	.8	42.8
1976	18.5	10.3	.0				4.6[5/]		33.4
1975	15.6	9.0	.0	.7	.2	.2	.0	.3	26.0
1972	4.6	10.9	.0	1.5	.7	.4	.0	.5	18.6
1970	5.4	7.3	.0				2.3[5/]		15.0
1969	12.7	4.5	.0	1.1	.2	.3	.0	.4[6/]	19.2
1968	8.4	8.0	.0				3.0[5/]		19.3
1966	10.7	8.3	.0				3.0[5/]		21.9
1965	10.3	8.0	.0				4.0[5/]		22.4
1963	5.3	5.9	.0				4.1[5/]		15.3
1960	8.6	8.7	.0				1.2[5/]		18.5
WISCONSIN									
1981	12.4	14.2	0.0				0.6		27.3
1980	5.2	14.3	.0[2/]				1.3		20.9
1976	9.8	20.8	.0				1.1		31.7
1975	10.9	20.4	.1				.3		31.7
1973	11.4	19.6	.0				1.2		32.2
1972	.1	18.2	.0				1.2		19.5
1970	.1	14.1	.0				.6		15.8
1968	.3	18.9	.0				1.9		21.1
1966	.6	20.5	.0				1.8		22.9
1965	.8	22.5	.0				1.1		24.4
1963	.5	23.8	.0				.9		25.2
1960	.5	24.2	.0				.8		25.5
MINNESOTA									
1980	2.5	3.5[2/]	0.0				0.5		6.5
1976	3.0	.4	.4				.7		4.5
1975	2.1	.4	.4				.3		3.2
1973	4.1	.4	.5				.2		5.2
1972	3.5	.4	.0				.3		4.2
1970	3.0	.3	.1				.1		3.5
1968	3.5	.5	.2				1.0		5.2
1966	5.2	.5	.1				.2		6.0
1965	6.1	1.1	.1				1.2		8.5
1963	6.1	3.0	.2				.6		9.9
1960	8.4	1.1	.5				.2		10.2

1/ USDA Forest Service, veneer log production and receipts, North Central Region.

2/ Minnesota and Wisconsin veneer log receipts were combined in 1980 survey. The study assumes that most of these receipts were within Wisconsin.

3/ Other states that receive Wisconsin and Minnesota exports include Indiana, Iowa, Kentucky and Missouri. Canada and other countries also receive some veneer log exports from Wisconsin and Minnesota.

4/ Less than 50 thousand board feet.

5/ Includes veneer logs shipped to states outside the Lake States and to Canada.

6/ Includes veneer logs shipped to Canada and other countries.

Table 61.--Veneer log production in the Lake States, Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, international 1/4-inch)

Year	Pine	Other softwoods	Aspen	Other hardwoods	Total
			LAKE STATES		
1980	0.3	0.0[2/]	20.3	43.6	64.2
1976	.4	.0	21.9	47.4	69.7
1975	.0	.0	24.2	36.7	60.9
1972	.0	.0	2.6	39.5	42.1
1970	.0	.0	1.3	33.2	34.5
1968	.0	.0	.6	45.0	45.6
1966	.1	.0	.7	50.1	50.9
1965	.0	.0	.6	53.8	54.4
1963	.0	.0	1.5	49.0	50.5
1960	.0	.0	2.1	51.9	54.0
			MICHIGAN		
1980	0.1	0.0	11.0	25.7	36.8
1978	.0	.0	16.0	19.0	35.0
1977	.0	.0	22.2	20.5	42.7
1976	.1	.0	11.0	22.3	33.4
1975	.0	.0	12.7	13.4	26.1
1972	.0	.0	.3	18.2	18.5
1970	.0	.0	.1	15.0	15.1
1969	.0	.0	4.0	15.2	19.2
1968	.0	.0	.2	19.1	19.3
1966	.0	.0	.3	21.6	21.9
1965	.0	.0	.4	22.0	22.4
1963	.0	.0	.3	15.0	15.3
1960	.0	.0	.2	18.3	18.5
			WISCONSIN		
1981	0.0	0.0	13.0	14.2	27.2
1980	.2	.0	5.8	14.9	20.9
1976	.3	.0	10.1	21.3	31.7
1975	.0	.0	11.1	20.5	31.6
1973	.0	.0	11.5	20.6	32.1
1972	.0	.0	2.1	17.3	19.4
1970	.0	.0	1.2	14.7	15.9
1968	.0	.0	.4	20.7	21.1
1966	.1	.0	.4	22.4	22.9
1965	.0	.0	.2	24.2	24.4
1963	.0	.0	.2	25.0	25.2
1960	.0	.0	1.3	24.1	25.4
			MINNESOTA		
1980	0.0	0.0	3.5	3.0	6.5
1976	.0	.0	.8	3.8	4.6
1975	.0	.0	.4	2.8	3.2
1973	.0	.0	.5	4.6	5.1
1972	.0	.0	.2	4.0	4.2
1970	.0	.0	.0	3.5	3.5
1968	.0	.0	.0	5.2	5.2
1966	.0	.0	.0	6.1	6.1
1965	.0	.0	.0	7.6	7.6
1963	.0	.0	1.0	9.0	10.0
1960	.0	.0	.6	9.5	10.1

[1/] USDA Forest Service, veneer log production and receipts, North Central Region.

[2/] Less than 50 thusand board feet.

Table 62.--Veneer log receipts in Michigan, Wisconsin, and Minnesota by state of origin[1/]

(All species, million board feet, international 1/4-inch)

Year	Origin					Total
	Michigan	Wisconsin	Minnesota	Other States[2/]	Canada	
MICHIGAN						
1980	22.1	5.2	0.0[3/]	0.0	0.0	27.3
1978	22.6	15.0	1.0	.5	.1	39.2
1977	30.4	.0	.0	.4	.0	30.8
1976	18.5	9.8	.4	.0	.0	28.7
1972	4.6	.1	.0	.0	.7	5.4
1970	5.4	.1	.1	.2	.9	6.7
1969	12.7	1.5	.3	.1	.5	15.1
1968	8.4	.3	.2	.3	.4	9.6
1966	10.7	.6	.1	.2	1.4	13.0
1965	10.3	.8	.1	.2	1.0	12.4
1963	5.3	.5	.2	.2	1.4	7.6
1960	8.6	.5	.5	.2	2.3	12.1
WISCONSIN						
1981	14.1	14.2	2.5	3.0	0.7	34.5
1980	9.0	14.3[4/]	2.5	1.6	.5	27.9
1976	10.3	20.8	3.0	2.4	.5	37.0
1973	10.9	19.6	4.1	2.0	1.2	37.8
1972	10.9	18.2	3.5	1.6	2.4	36.6
1970	7.3	15.1	3.0	1.7	2.7	29.8
1968	8.0	18.9	3.5	2.7	4.5	37.6
1966	8.3	20.5	5.2	2.6	5.6	42.2
1965	8.0	22.5	6.1	1.6	4.8	43.0
1963	5.9	23.8	6.1	1.7	4.3	41.8
1962	5.0	18.8	6.2	2.8	4.8	37.6
1960	8.7	24.2	8.4	5.2	4.8	51.3
MINNESOTA						
1980	0.0	0.0	3.5[4/]	0.0	0.0	3.5
1976	.0	.0	.4	.1	.0	.6
1972	.0	.0	.4	.0	.0	.5
1970	.0	.0	.3	.0	.0	.4
1968	.0	.0	.5	.0	.0	.5
1966	.0	.0	.5	.0	.0	.5
1965	.0	.0	1.1	.0	.0	1.1
1963	.0	.0	3.0	.0	.1	3.1
1960	.0	.0	1.1	.0	.0	1.1

[1/] USDA Forest Service, veneer log production and receipts, North Central Region.

[2/] Includes shipments from Iowa, Illinois, Indiana, Kentucky, Ohio, and Pennsylvania and small amounts from other Central and Western States.

[3/] Less than 50 thousand board feet.

[4/] Minnesota and Wisconsin veneer log receipts were combined in 1980 survey. The study assumes that most of these receipts were within Wisconsin.

Table 63.--Veneer log receipts in the Lake States, Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, international 1/4-inch)

Year	Pine	Other softwoods	Aspen	Other hardwoods	Total
			LAKE STATES		
1980	0.2	0.0[2/]	19.9	38.5	58.6
1976	.4	.0	21.5	44.5	66.4
1972	.0	.0	2.4	39.9	42.3
1970	.0	.0	1.3	35.8	37.1
1968	.0	.0	.6	47.0	47.6
1966	.1	.0	.7	54.6	55.4
1965	.0	.0	.6	56.0	56.6
1963	.0	.0	1.5	51.2	52.7
1960	.0	.0	2.1	62.3	64.4
			MICHIGAN		
1980	0.0	0.0	15.7	11.5	27.2
1978	.0	.0	31.7	7.4	39.1
1977	.0	.0	22.2	8.7	30.9
1976	.1	.0	21.0	7.7	28.8
1972	.0	.0	.2	5.1	5.3
1970	.0	.0	.1	6.7	6.8
1969	.0	.0	5.1	10.0	15.1
1968	.0	.0	.2	9.4	9.6
1966	.0	.0	.2	12.6	12.8
1965	.0	.0	.3	12.1	12.4
1963	.0	.0	.2	7.4	7.6
1960	.0	.0	.0	12.1	12.1
			WISCONSIN		
1981	0.2[3/]	0.0	0.6	33.8	34.6
1980	.2	.0	.7	27.0	27.9
1976	.3	.0	.5	36.2	37.0
1973	.0	.0	.4	37.3	37.7
1972	.0	.0	2.2	34.3	36.5
1970	.0	.0	1.2	28.7	29.9
1968	.0	.0	.4	37.1	37.5
1966	.1	.0	.5	41.5	42.1
1965	.0	.0	.3	42.8	43.1
1963	.0	.0	.3	41.6	41.9
1960	.0	.0	2.1	49.2	51.3
			MINNESOTA		
1980	0.0[3/]	0.0	3.5	0.0	3.5
1976	.0	.0	.0	.6	.6
1973	.0	.0	.1	.4	.5
1972	.0	.0	.0	.5	.5
1970	.0	.0	.0	.4	.4
1968	.0	.0	.0	.5	.5
1966	.0	.0	.0	.5	.5
1965	.0	.0	.0	1.1	1.1
1963	.0	.0	1.0	2.2	3.2
1960	.0	.0	.0	1.0	1.1

1/ USDA Forest Service, veneer log production and receipts, North Central Region.

2/ Less than 50 thousand board feet.

3/ Minnesota and Wisconsin veneer log receipts were combined in 1980 survey. The study assumes that most of these receipts were within Wisconsin.

Table 64.--Veneer log imports into Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, International 1/4-inch rule)

Year	Pine	Other softwoods	Aspen	Other hardwoods	Total
			MICHIGAN		
1980	0.0[2/]	0.0	5.2	0.0	5.2
1978	.0	.0	16.0	.6	16.6
1977	.0	.0	.0	.5	.5
1976	.1	.0	10.0	.2	10.3
1972	.0	.0	.0	.8	.8
1970	.0	.0	.0	1.3	1.3
1969	.0	.0	1.1	1.2	2.3
1968	.0	.0	.0	1.2	1.2
1966	.0	.0	.0	2.1	2.1
1965	.0	.0	.0	2.1	2.1
1963	.0	.0	.0	2.3	2.3
1960	.0	.0	.0	3.4	3.4
			WISCONSIN		
1981	0.1	0.0	0.0	20.2	20.3
1980	.1[3/]	.0	.2	13.4	13.5
1976	.1	.0	.0	16.1	16.2
1973	.0	.0	.2	17.9	18.1
1972	.0	.0	.1	18.3	18.4
1970	.0	.0	.0	14.7	14.7
1968	.0	.0	.0	18.7	18.7
1966	.0	.0	.1	21.6	21.7
1965	.0	.0	.0	20.5	20.5
1963	.0	.0	.1	18.0	18.1
1960	.0	.0	.7	26.3	27.0
			MINNESOTA		
1980	0.0[3/]	0.0	0.0	0.0	0.0
1976	.0	.0	.0	.2	.2
1972	.0	.0	.0	.1	.1
1970	.0	.0	.0	.1	.1
1968	.0	.0	.0	.0	.0
1966	.0	.0	.0	.0	.0
1965	.0	.0	.0	.0	.0
1963	.0	.0	.0	.1	.1
1960	.0	.0	.0	.0	.0

1/ USDA Forest Service, veneer log production and receipts, North Central Region.

2/ Less than 50 thousand board feet.

3/ Minnesota and Wisconsin veneer log receipts were combined in 1980 survey. The study assumes that most of these receipts were within Wisconsin.

Table 65.--Veneer log exports from Michigan, Wisconsin, and Minnesota by species group[1/]

(In million board feet, international 1/4-inch)

Year	Pine	Other softwoods	Aspen	Other hardwoods	Total
			MICHIGAN		
1980	0.1	0.0[2/]	0.5	14.2	14.8
1978	.0	.0	.2	12.2	12.4
1977	.0	.0	.0	12.3	12.3
1976	.1	.0	.0	14.7	14.8
1975	.0	.0	.0	10.5	10.5
1972	.0	.0	.0	13.9	13.9
1970	.0	.0	.0	9.6	9.6
1969	.0	.0	.0	6.5	6.5
1968	.0	.0	.0	11.0	11.0
1966	.0	.0	.1	11.2	11.3
1965	.0	.0	.0	12.0	12.0
1963	.0	.0	.1	10.0	10.1
1960	.0	.0	.2	9.9	10.1
			WISCONSIN		
1981	0.0	0.0	12.4	0.6	13.0
1980	.0	.0	5.2[3/]	1.3	6.5
1976	.1	.0	9.6	1.2	10.9
1975	.0	.0	10.9	.4	11.3
1973	.0	.0	11.3	1.3	12.6
1972	.0	.0	.0	1.3	1.3
1970	.0	.0	.0	.7	.7
1968	.0	.0	.0	2.2	2.2
1966	.0	.0	.0	2.4	2.4
1965	.0	.0	.0	1.9	1.9
1963	.0	.0	.0	1.4	1.4
1960	.0	.0	.0	1.2	1.2
			MINNESOTA		
1980	0.0[3/]	0.0	0.0	3.0	3.0
1976	.0	.0	.8	3.4	4.2
1975	.0	.0	.4	2.4	2.8
1973	.0	.0	.4	4.3	4.7
1972	.0	.0	.2	3.6	3.8
1970	.0	.0	.0	3.1	3.1
1968	.0	.0	.0	4.7	4.7
1966	.0	.0	.0	5.6	5.6
1965	.0	.0	.0	6.5	6.5
1963	.0	.0	.0	6.9	6.9
1960	.0	.0	.6	8.5	9.1

1/ USDA Forest Service, veneer log production and receipts, North Central Region.

2/ Less than 50 thousand board feet.

3/ Minnesota and Wisconsin veneer log receipts were combined in 1980 survey. The study assumes that most of these receipts were within Wisconsin.

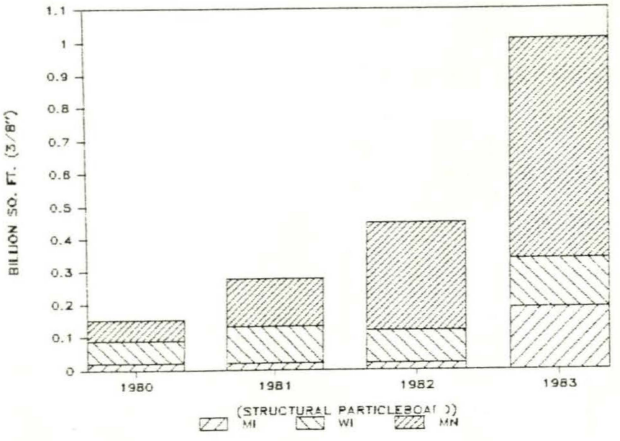

Figure 48.—*Structural panel production in the Lake States.*

Table 66.--Structural panel production in the Lake States[1/]

(In million square feet, 3/8-inch)

Year	Michigan	Minnesota	Wisconsin	Total
1983	185(2)[2/]	670(4)	151(1)	1,006
1982	21(2)	328(3)	99(1)	448
1981	19(1)	148(3)	111(1)	278
1980	20(1)	65(1)	70(1)	155

1/ Anderson 1984. By definition, structural panel includes softwood plywood, waferboard, oriented strand board and composite plywood. Waferboard and OSB comprise most of the production in the Lake States and are referred to as structural particleboard throughout the study.

2/ Number in parentheses shows number of mills.

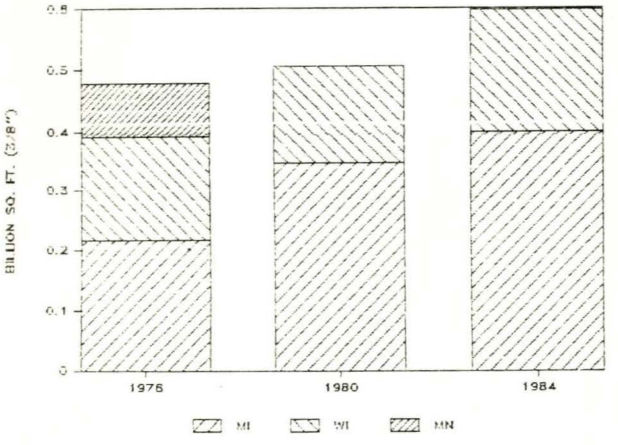

Figure 49.—*Particleboard productive-capacity in the Lake States.*

Table 67.--Particleboard productive-capacity in the Lake States[1/]

(In million square feet, 3/4-inch)[2/]

Year	Michigan	Minnesota	Wisconsin	Total
1984	200(1)[3/]	--	99(2)	299
1981	180(1)	--	91(2)	271
1980	172(1)	--	81(2)	253
1976	108(1)	45(2)	86(2)	239

1/ National Particleboard Association. Lake States mills produce "platenboard" or "mat-formed" particleboard which is used primarily in industrial markets.

2/ Double production data to obtain 3/8-inch basis for comparison.

3/ Number in parentheses shows number of mills.

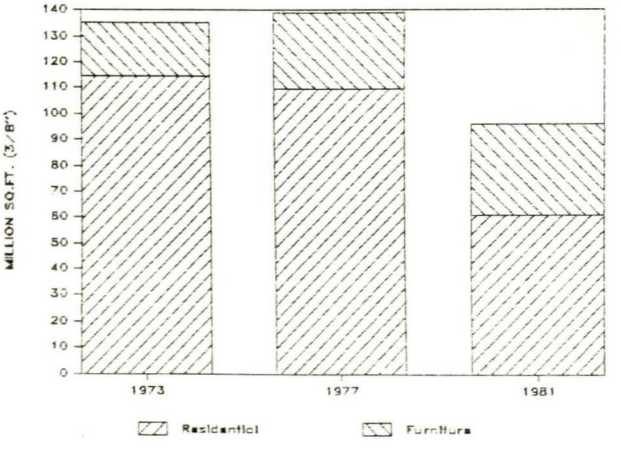

Figure 50.—*Lake States particleboard consumption by end use.*

Table 68.--Particleboard used in single-family home construction in the Lake States, Michigan, Wisconsin, and Minnesota[1/]

(In 3/4-inch basis)

Year	Construction permits[2/]	Square feet per home[3/]	Total
	Thousand		Million square feet
LAKE STATES			
1981	34.5	0.52	17.9
1977	92.7	.38	34.9
1973	82.4	.30	24.6
MICHIGAN			
1981	11.1	0.52	5.8
1977	39.3	.38	14.8
1973	45.6	.30	13.6
WISCONSIN			
1981	8.2	0.52	4.3
1977	27.7	.38	10.4
1973	21.9	.30	6.5
MINNESOTA			
1981	15.2	0.52	7.9
1977	25.7	.38	9.7
1973	14.9	.30	4.4

1/ By USDA Forest Service definition, particleboard includes waferboard, oriented-strand board, composite board, and medium-density fiberboard.

2/ U.S. Department of Commerce, International Trade Administration.

3/ Based on interpolations, USDA Forest Service (1982).

Table 69.--Particleboard used in multi-family home construction in the Lake States, Michigan, Wisconsin, and Minnesota[1/]

(In 3/4-inch basis)

Year	Construction permits[2/]	Square feet per home[3/]	Total
	Thousand		Million square feet
LAKE STATES			
1981	20.3	0.16	3.1
1977	45.6	.11	4.9
1973	58.0	.09	4.9
MICHIGAN			
1981	7.6	0.16	1.2
1977	19.4	.11	2.1
1973	32.1	.09	2.7
WISCONSIN			
1981	5.7	0.16	0.9
1977	13.6	.11	1.5
1973	15.4	.09	1.3
MINNESOTA			
1981	7.0	0.16	1.1
1977	12.6	.11	1.3
1973	10.5	.09	.9

1/ By USDA Forest Service definition, particleboard includes waferboard, oriented-strand board, composite board, and medium-density fiberboard.

2/ U.S. Department of Commerce, International Trade Administration.

3/ Based on interpolations, USDA Forest Service (1982).

Table 70.--Particleboard used in new mobile homes in the Lake States, Michigan, Wisconsin, and Minnesota[1/]

(In 3/4-inch basis)

Year	Shipments[2/]	Square feet per home[3/]	Total
	Thousand		Million square feet
LAKE STATES			
1981	11.4	0.85	9.6
1977	17.5	.86	15.0
1973	39.0	.71	27.7
MICHIGAN			
1981	4.3	0.85	3.6
1977	7.5	.86	6.4
1973	22.3	.71	15.8
WISCONSIN			
1981	3.1	0.85	2.6
1977	5.0	.86	4.3
1973	10.0	.71	7.1
MINNESOTA			
1981	4.0	0.85	3.4
1977	5.0	.86	4.3
1973	6.7	.71	4.8

1/ By USDA Forest Service definition, particleboard includes waferboard, oriented-strand board, composite board, and medium-density fiberboard.

2/ U.S. Department of Commerce, International Trade Administration. Mobile home shipments to the Lake States are estimated from shipments to North Central region, assuming that each State's share is the same as its share of residential construction within the region.

3/ Based on interpolations, USDA Forest Service (1982).

Table 71.--Particleboard used in furniture manufacturing in the Lake States, Michigan, Wisconsin, and Minnesota[1/]

(In 3/4-inch basis)

Year	U.S. consumption[2/]	State share[3/]	State consumption
	Million square feet	Percent	Million square feet
		LAKE STATES	
1981	1,739	11.5	200.0
1977	1,476	10.9	160.9
1973	1,145	9.0	103.1
		MICHIGAN	
1981	1,739	8.0	139.1
1977	1,476	7.5	110.7
1973	1,145	6.0	68.7
		WISCONSIN	
1981	1,739	2.5	43.5
1977	1,476	2.4	35.4
1973	1,145	2.1	24.0
		MINNESOTA	
1981	1,739	1.0	17.4
1977	1,476	1.0	14.8
1973	1,145	.9	10.3

1/ By USDA Forest Service definition, particleboard includes waferboard, oriented-strand board, composite board and medium-density fiberboard.

2/ Based on interpolations, USDA Forest Service (1982).

3/ U.S. Department of Commerce, Bureau of the Census, Census of Manufactures. Assumes that the region's share of value-added in SIC 25, Furniture and Fixtures, represents its share of the nation's total lumber consumption in furniture manufacturing. Trends shown in 1972 and 1977 are extended to 1981.

Table 72.--Residential fuelwood consumption in the Lake States[1/]

(In million standard cords)

Year	Michigan	Wisconsin	Minnesota	Total
1982	3.20			
1981	2.90	2.02[3/]		
1980	1.65[2/]	1.37	1.37	4.39

1/ Residential fuelwood surveys conducted by state departments of natural resources, in cooperation with Northeastern Area State and Private Forestry, USDA Forest Service.

2/ James, et al. (1982).

3/ Blyth (1981).

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Gray, Gerald J.; Ellefson, Paul V.; Lothner, David C.
Production and consumption of major wood products in the Lake States: perspectives and trends. Gen. Tech. Rep. NC-108. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1986. 82 p.

Estimates are developed of primary and secondary wood product production and consumption in the Lake States (Michigan, Wisconsin, and Minnesota) between 1960 and 1980. Consumption estimates are derived through application of the use-factor approach. Increased cooperation among forestry agencies in the three states appears to hold significant regional benefits.

KEY WORDS: Paper and board, lumber, plywood and veneer, particleboard, fuelwood, derived demand, use-factor, demand indicators, policy implications, regional cooperation, research needs.

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